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ELECTRICAL WORLD

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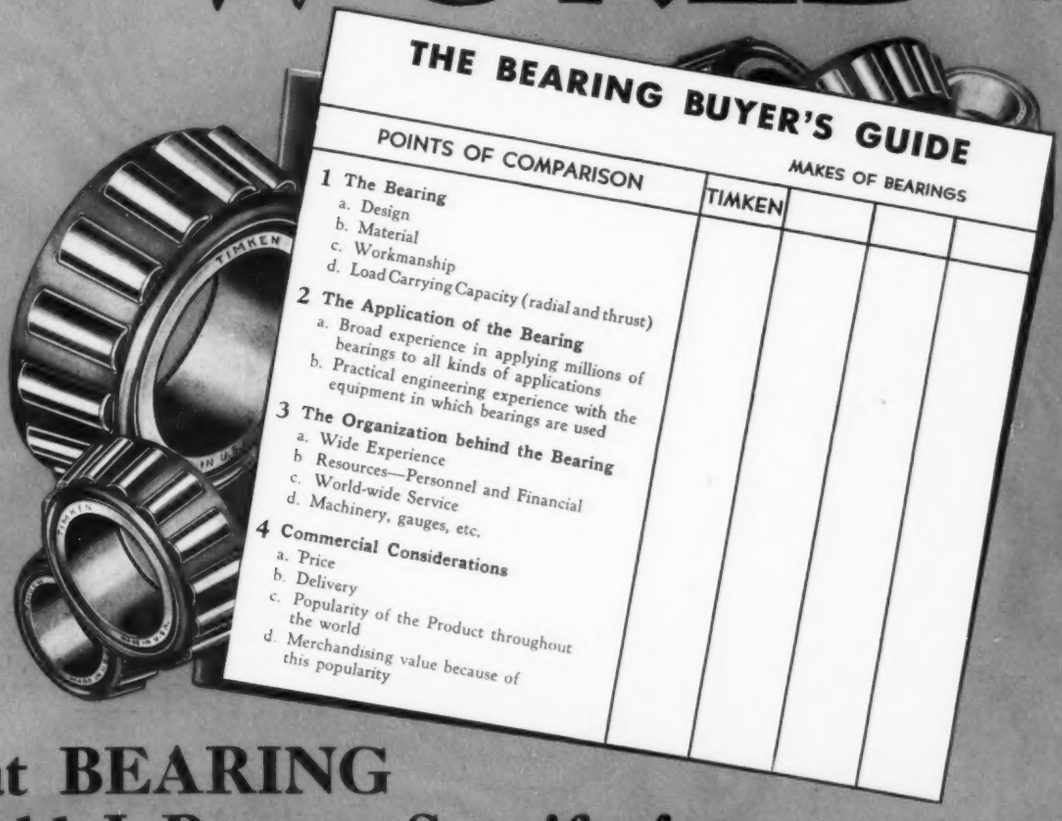
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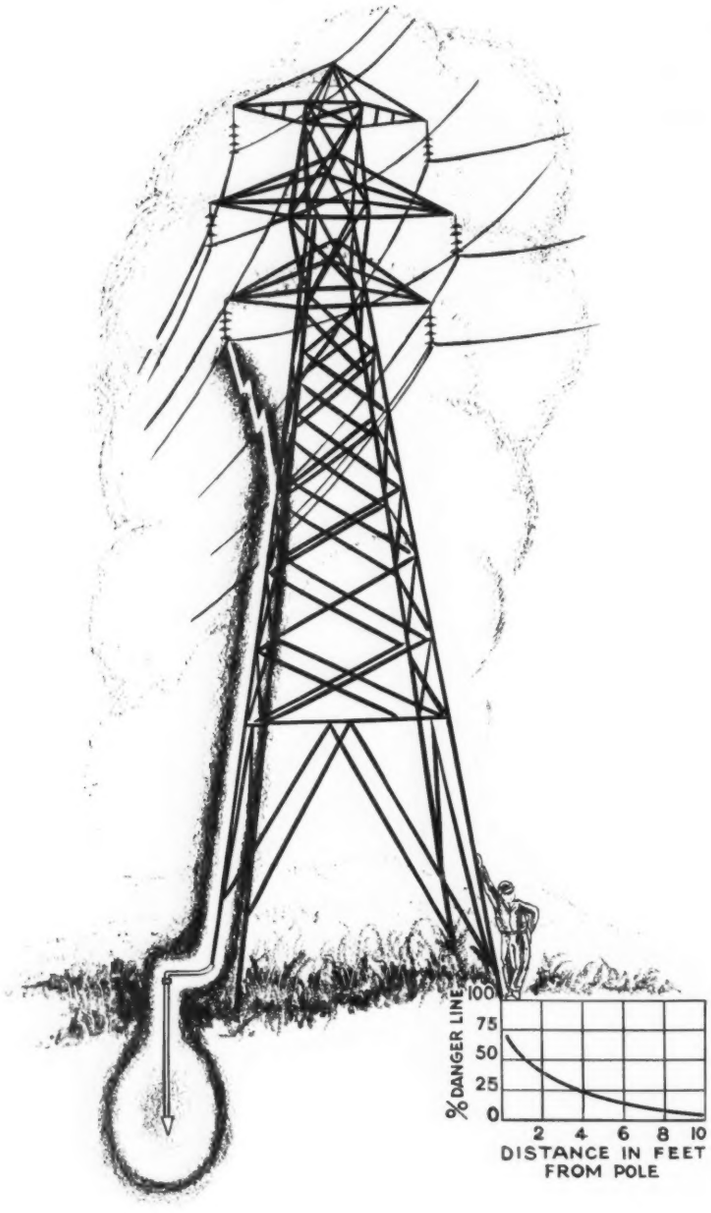

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ELECTRICAL WORLD

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What in the World!

Electric house heating in winter and air conditioning in summer should be a goal for America. Why, then, doesn't the government in the erection of public buildings and the T.V.A. in its electrification projects specify, or at least accept, these conveniences? What a marvelous impetus would be given to these applications if they would become interested!

●

So far as we see the federal monetary program will have little immediate influence upon the electrical industry. It is a move toward greater stabilization only.

●

Utility investors are organizing in order to be heard. This is a splendid idea, but no one should get an exaggerated conception of the influence of a minority group of citizens. The general hostility to utilities must be removed and deeper and broader moves are needed than the simple use of investor pressure.

●

Next week there will be a complete report of the A.I.E.E. convention. A large attendance is anticipated and the discussions of the technical papers are expected to bring out new information and some clashes of opinion. All this makes for engineering progress.

●

Codes for utilities, manufacturers, wholesalers and retailers are still in process of compilation or amendment. So far little actual accomplishment is had in improving trade practices. In such a complex industry this should be expected. It will take years to bring fair practice ideas to practical consummation.

L. W. W. MORROW, Editor

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January 27, 1934

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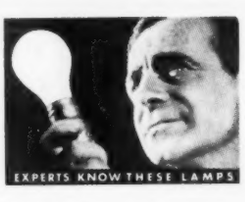

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ELECTRICAL WORLD

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for the Week Ending

January 27, 1934

L. W. W. MORROW, *Editor*

Form an Industry Executive Committee

MANY conditions confronting the electrical industry and its several branches make it logical to revive and apply an old idea. This is the formation of a central executive committee upon which executives of all branches are placed so that decision might be made to the advantage of the entire industry.

Several recent developments force consideration and action on this suggestion. The first is the adoption of codes of fair practice by all the branches of the industry. There are conflicts in these codes, there are disputes as to jurisdiction, there are disputes as to distribution practices and there are many possibilities for the adoption of common code policies and practices. Agreement and simplification cannot be had through individual code hearings in Washington; they can be had, however, if executives of all branches come together in a central organization and have placed before them these problems for solution. Based upon the code situation alone, a central executive committee should be organized at once; it should represent the manufacturers, the utilities, the wholesalers, the contractors and the retailers.

A second element that supports the idea of the central committee is the industry sales problem. All branches must sell their way out of this depression. Sales methods, including financing, distribution channels, sales promotion and sales accounting, have changed and are affected by the codes. New-business possibilities such as electric cooking, air conditioning, water heating and house heating will require enormous sums of money for adequate sales promotion, and this burden must be shared by all. Even the industrial market is changed from one of expansion to one of rehabilitation and new policies and practices must be used by all branches in selling this market. All markets are unsaturated, but all have changed, and the industry as a whole must change to meet the new conditions.

There are other major problems also that should receive consideration by this central authority. American Standards Association will be compelled to add commercial standardization, processing standardization and consumer quality standardization to its engineering standardization. The industry should approach these new departures with a common policy and support them as a unit. There are relations with the government, especially with respect to utility projects, that introduce new problems for industry consideration; there are new conditions with respect to labor that need study, and there are matters of public policy upon which the industry should act and should be heard as a unit.

But the mere organization of a central committee and the appointment of representatives is not enough. This was evident in the history of S.E.D. There must be definite channels established for bringing industry problems to the executives for decision. There must be definite methods to enforce

the central committee decisions. All this can be done and should be done as quickly as possible. Conditions, especially with respect to the codes, are getting out of hand rapidly and it is imperative that some form of central executive organization be instituted as soon as possible.

Quality appliance testing

Debate has been had as to the value and the possibility of testing domestic appliances for quality and for consumer values. In this issue the article by E. H. Salter, describing tests of automatic electric flatirons, shows facts and permits deductions that should clarify the situation. Tests that show quality were made and quite definite conclusions as to quality and for the improvement of irons are available. These tests do not cover all consumer aspects of quality and use, but they do show that tests may be made and conclusions drawn that are very valuable. They indicate the practical feasibility of quality testing.

Pressure for quality testing increases and sooner or later the industry as a whole will be compelled to take action. We have suggested that the American Standards Association, properly reorganized or departmentalized, is the logical industry organization to undertake preliminary studies of the possibilities of quality appliance testing and to develop the plan and program that are practical to use in the development of this work. This is a problem that requires executive and commercial consideration at this stage and the engineering features of test specifications should follow and not precede an organized industry plan developed under A.S.A. auspices. Consideration of this movement should be had as promptly as possible.

Municipal operation fails in Berlin

Various European examples of governmental utility operation have frequently been cited in arguments for the cause of public ownership in the United States. One of the finest of these examples has recently dropped from the list. Berlin, Germany, has sold its municipal electricity system to a private syndicate. The reported price is $132,000,000 plus $7,000,000 in stock of the buying corporation. Report further says that "Berlin got out before municipal socialism bankrupted the city. She had a deficit of $25,000,000 in 1930 and a further loss of $30,000,000 in 1931. These great losses do not include the loss of taxes, which would show a further loss of just around $5,000,000 per year."

It is difficult to see how an electricity system which was sold for $139,000,000 could have shown deficits of the order of those above quoted. They apparently are total municipal deficits, not for the utility operation alone. The stated annual loss of $5,000,000 in taxes does not look particularly convincing either. These admissions are made to forestall criticism and because we feel that the debonair and nonchalant handling of large money figures by public ownership enthusiasts does not license the private enterprise defender in the same carelessness. However, the fact remains that Berlin has turned over its electric utility system to private operation and there is a vacant place in the front of shining shields advancing upon individualism.

Industry needs instruments

Industrial production machines require the closest possible scrutiny of their operations by management in this period. To get the necessary data electrical instruments, either of the recording, indicating or totalizing type, should be installed permanently on individual machines. These would afford management information to analyze, supervise and standardize the operations of the machine.

This purpose of metering counters directly the customary sale and use of meters for power cost accounting and testing. This change, therefore, requires that electrical engineers and manufacturers of meters must become better informed on the production and management problems in industry in order to use meters and to sell meters in this new market. There is a great opportunity to redesign old meters and to build new ones. There is a great opportunity for industrial plant engineers to enhance their position and aid their managements by the more intelligent consideration of this type of industrial instrumentation.

Another important aspect of this problem is to get the manufacturers of production machinery to specify and possibly build in the proper

instrumentation and controls for their machines. In addition, there needs to be serious study given to arrive at a determination of data that are desirable and at a management analysis and application of the data to current production. The validity of this new conception of industrial instrumentation lies in its practical application to contemporaneous production and not to *ex post facto* analyses.

Base reserves on probability law

Reliability of service is primarily a matter of having enough reserve capacity in production and delivery facilities to compensate for accidental and deliberate removal of facilities from service. In turn, serviceability is a matter of statistics on maintenance and of the probability of unscheduled outages. At the moment there is worry about absorbing excess capacities. Shortly the worry will be where first to make provision most advantageously for sustained reliability under rising loads. The problem was intricate when no one encountered difficulty in getting the money for additions, and it is even more intricate now. It is self-evident that such intricacy can best be solved by breaking the problem into its components. One component is the part that pure probability plays in all such affairs.

Probability as a branch of mathematical science gives the readiest and most convincing answers when numbers of specimens are great and numbers of possible eventualities few. Neither of these desirable conditions exists for electrical systems, which are subject to a multitude of disturbances all the way from interrupted fuel supply at the station to a lightning-punctured meter. But each part of the system has its touch of frailty. What are the facts, statistically, about these independent causes of service interruption? What are the probabilities that they will happen simultaneously at different points in the system to make in the aggregate more than a certain number of minutes' service interruption per year for any type of customer? What are the probabilities that more than the existing reserve capacity at any point will be unavailable at any time?

Citing the dependence of such happenings upon mathematical degrees of certainty does not imply that reserve capacities can be set down by one slide rule operation. It does mean that the probability theory has generally been overlooked as a partial substitute for and a wholesome bolster for "good engineering judgment." Good engineering judgment can always be made better.

The actuary would first view the accumulating mass of system outage data as just so many terms in his probability formulas. Not that he would then base his insurance charges solely on the numerical result. Maybe he would conclude that a dollar spent to improve the health and security of his human risks would justify a corresponding modification of his premiums. Likewise, actuarial analysis might help decide just where dollars could best be spent among stations, lines and distribution to clip something off the size of the probability-of-failure index. In short, some of the unbalance in reserves that differ so widely from system to system and within systems could be corrected by applying a bit more of the actuaries' probability technique to the systems.

"Building poorly lighted"

"For the sake of economy the bank building has not been lighted extensively and there was only one electric lamp available outside the vault." This sentence occurs in the account of a safety vault robbery printed by the Chicago *Daily Tribune,* December 14, 1933. The details:

> Seven robbers carrying cold chisels and sledge hammers as well as pistols and shotguns invaded the safety deposit vaults in the old Unity Trust and Savings Bank at 3909 West North Avenue yesterday afternoon, took five men prisoners, and after working for more than three hours fled with the contents of 96 boxes which they had smashed.

The story goes on to say that, because of the poor lighting, not one of the five victims trussed up by the robbers got a sufficiently good look at the criminals to be able to identify any of them. Undoubtedly the fact that the place had little light entered importantly into the plans of the robbers as they prepared their invasion, "carrying cold chisels and sledge hammers as well as pistols and shotguns." Possibly good lighting might not have kept the robbers away; possibly it might have. The robbers did not hang around after the job was done to give out any interviews on this point. However, it is well known that crime loves the dark.

Predicting Iron Performance and Factors That Improve It

By E. H. SALTER
Research Engineer Electrical Testing Laboratories, New York

When a prospective purchaser of domestic electric equipment is confronted with different makes of the same appliance, visual examination or general statements by the seller do not always give him a satisfactory basis for judging their relative ability to perform the tasks for which they were intended. As a consequence he is not able to recognize all that contributes to quality and satisfaction with service and buys almost entirely on price. Even the retail seller is frequently handicapped by having no definite yardstick with which to judge the customer satisfaction which may be expected with different devices.

Out of this situation has grown the suggestion that there should be developed some way of rating those hidden elements of quality which never reveal themselves until after use. In this article the author considers a specific device—the adjustable automatic flatiron—and by results of extensive research shows it is possible to predict service results very closely from data fairly readily obtained. More than that, his studies indicate very tangibly the factors which must be considered by manufacturers to give maximum customer satisfaction.

Possibly equally thorough analysis of other equipment from the service point of view will lead to improved development or selling ammunition even if the answer to quality rating is not the outcome.

EXTENSIVE tests of the performance of adjustable automatic electric flatirons have led to a new approach to the evaluation of flatiron performance and to the design of the most effective units of this type. By means of the ironing duty curves for two standardized ironing loads a direct connection has been established between the calorimeter test and practical ironing. By means of these curves and corresponding curves of heat energy requirements it becomes possible to predict very accurately the performance of a flatiron once the calorimeter curve is known. Furthermore, since the duty curves are the average of a large number of tests, the predicted performance should provide a method of comparing flatirons on a performance basis, which is more accurate and reliable than practical ironing tests because of the many variables in the latter which can be only partially controlled.

Before this new approach to quality comparison and improvement of design is discussed, however, it is necessary to refer to tests which contributed to its development. It is also necessary to emphasize that the discussion is based exclusively on adjustable automatic irons, although it may be observed that some of the comments will apply to the non-adjustable type and electric irons in general.

Temperature Control—If the thermostat is completely effective a constant temperature will be maintained at the ironing surface or soleplate regardless of the rate of heat withdrawal from the soleplate up to the full output of the iron. Very wide differences in this respect are found, however, among the various makes of irons on the market, as shown in Fig. 1 by the group of typical "calorimeter curves" where the thermostats are set for the highest adjustable temperature. The line representing the automatic operation of the iron, *a-b,* would be a horizontal straight line if the thermostat held the soleplate at a definite temperature. However, because of the design and location limitations of thermostats now being used, and the thermal resistance between the heater element and the ironing surface, this condition is not attained, although, as indicated by curves 202-E, 213-D and 216-B, it is approached in some irons. On the other hand, there are other irons, such as 187-B and 206, in which the soleplate temperature drops so rapidly under loading that the non-automatic condition is not reached within the range of soleplate temperatures which are useful for ironing. In these cases the entire calorimeter curve, *a-a'*, represents automatic operation.

Engineering judgment would suggest that the iron showing a comparatively flat calorimeter curve should be a better iron than one in which temperature decreases rapidly with increased load. But it was deemed advisable to show by actual ironing trials which of these irons would really be the more effective in ironing.

Practical Ironing Tests—After many attempts to conduct practical ironing tests it became evident that to obtain consistently comparable results it would be necessary to limit the tests to ironing by one thoroughly trained, skilled operator, working on carefully prepared ironing loads of definite and fixed quantities of materials.

A "professional" ironer from a commercial laundry was hired who had that sense of judgment which would insure completion of the ironing job without loss of effort due to over-ironing.

To control the variable due to the materials to be ironed two groups of materials were employed, designated as heavy-duty load and medium-duty load respectively. The heavy-duty load consisted of five pieces of

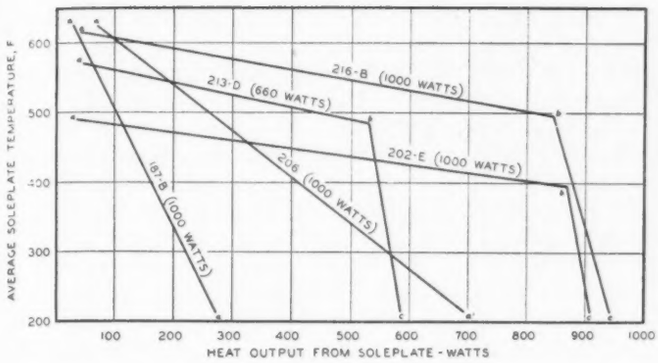
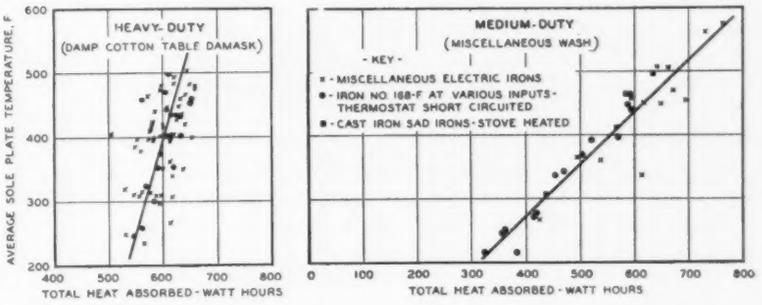


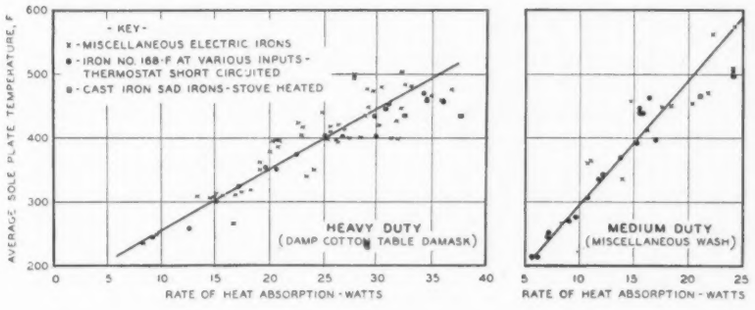
Fig. 1—Relative effectiveness of temperature control of different irons on high setting

The average soleplate temperature at each rate of heat output was obtained with a calorimeter. Ideal control would maintain constant temperature at any output within the rating of the unit, hence the approach of these calorimeter curves to horizontal lines indicates the effectiveness of the control. Points "a" represent idling temperature, i.e., with iron on stand or heel rest. Under this condition the thermostat remains "on" only a fraction of the time, but as the output increases it is closed a greater portion of the time. Beyond the point (b) the iron becomes non-automatic because the thermostat is closed all the time. Naturally the output at which a 660-watt iron becomes non-automatic is lower than that for a 1,000-watt iron.

Figs. 2 and 3—Heat absorbed by heavy-duty and medium-duty loads in practical ironing tests

Based on data taken in 103 ironing trials. If the heat delivered by the soleplate were entirely absorbed in converting a constant quantity of water into steam it would be a constant value independent of temperature and the mean lines would be vertical. But the heat that goes into material other than water varies with temperature and makes the mean lines slope to right; that in Fig. 3 more than in Fig. 2 because the medium-duty load contained a much smaller quantity of water—about 8.7 per cent by weight compared with 42.8 per cent for the heavy-duty load.


HEAVY-DUTY
(DAMP COTTON TABLE DAMASK)
AVERAGE SOLE PLATE TEMPERATURE, F
TOTAL HEAT ABSORBED - WATT HOURS
MEDIUM-DUTY
(MISCELLANEOUS WASH)
- KEY -
x - MISCELLANEOUS ELECTRIC IRONS
• - IRON NO. 168-F AT VARIOUS INPUTS - THERMOSTAT SHORT CIRCUITED
• - CAST IRON SAD IRONS - STOVE HEATED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x - MISCELLANEOUS ELECTRIC IRONS
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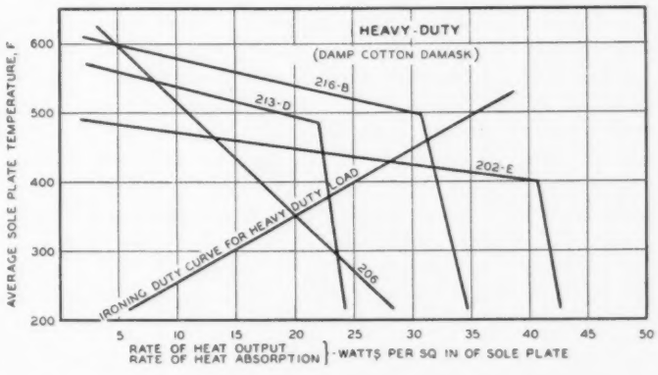
• - CAST IRON SAD IRONS - STOVE HEATED
AVERAGE SOLE PLATE TEMPERATURE, F
HEAVY DUTY
(DAMP COTTON TABLE DAMASK)
RATE OF HEAT ABSORPTION - WATTS
MEDIUM DUTY
(MISCELLANEOUS WASH)
RATE OF HEAT ABSORPTION - WATTS

Figs. 4 and 5—Rate of heat absorption in heavy-duty and medium-duty ironing per unit soleplate area

Based on more than 100 ironing trials. The heat absorption is given per square inch of soleplate area to eliminate effect of variations in size, and is expressed in watts output because the calorimeter test is inherently a rate measurement.

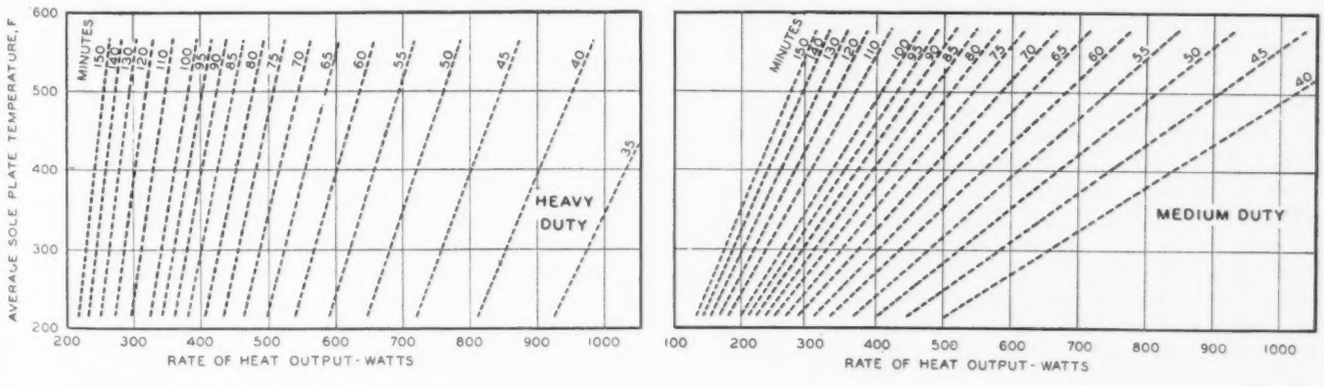
Fig. 6—Calorimeter and duty curves permit prediction of performance

These curves duplicate those in Figs. 1 and 4. Their use in conjunction with such data as in Fig. 2, for predicting performance, is explained in Table I.



Figs. 7 and 8—Thermal-rate curves indicate conditions essential to completion of ironing in fixed time

Derived by dividing abscissas of Figs. 2 and 3 by given time values.



heavy cotton damask table cloth, each one yard wide and two yards long. Before each ironing operation they were thoroughly saturated with water and then run for a total of four minutes in a centrifugal drier. The total weight of dry cloth was about 3½ lb. and, when ready for ironing, approximately 5 lb. The medium-duty load was made up of 25 items representing a general assortment of wearing apparel and household "linens" proportioned after a miscellaneous family wash. These pieces were prepared for ironing by hanging them for not less than sixteen hours in a room in which the air is held at 90 per cent relative humidity at a temperature of 65 to 70 deg. F. The total weight of the dry pieces was about 11½ lb. and, when ready for test, about 12½ lb.

Repeated tests with this combination of operator and materials soon showed that tests could be duplicated after days or even weeks had elapsed with maximum variations from average time of ironing of only 10 per cent.

Ironing tests were made with 32 different adjustable automatic flatirons under these control conditions. In many cases tests were repeated for check purposes, with the result that a total of 103 of these practical ironing tests was made. In every case the test was made with the thermostat adjusted to its highest setting, i.e., to give the maximum temperature at which the iron would operate on a given load. The usual measurements of soleplate temperature, electrical quantities, time, etc., were made continuously throughout each ironing trial.

It is, of course, desirable that an iron be capable of performing a given ironing task in the shortest time without the use of temperatures so high that scorching occurs. The longest time taken in these trials to iron the heavy-duty load was 168 minutes, but the corresponding average soleplate temperature was only 235 deg. F. —a temperature barely high enough to evaporate water. On the other hand, the shortest time taken on this same load was 42 minutes and the corresponding average soleplate temperature was 463 deg. F. Other irons approximating this maximum ironing speed showed average soleplate temperatures as high as 503 deg. F. In no case was there any indication of scorching, nor did the operator make any comment about the hotter irons being too hot.

With the medium-duty load the slowest work was done with an iron which operated at 266 deg. F., the time being 135 minutes. The most rapid iron required only 69 minutes, with an average soleplate temperature of 507 deg. F. Certain irons used at this load operated at average temperatures as high as 561 to 574 deg. F., but in these cases the operator felt there was danger of scorching the materials.

These trials showed that the practical ironing test could be employed as a laboratory method of comparing irons. However, the method could only yield approximate results, since a deviation of the order of 10 per cent has to be expected unless each test was repeated several times in order to obtain an accurate average value, in which case the cost becomes prohibitive. An analysis of the problem and of the large amount of ironing trial data obtained indicated that it would be possible to predict the performance on these standard ironing loads directly from the calorimeter curve without actually making an ironing trial. Such a proposal is presented in the discussion which follows:

Heat Flow in Ironing Process—Of the heat supplied to the work through the soleplate, a portion converts the water in the cloth into steam and the balance is absorbed by the material being ironed, the ironing board itself, etc. The total heat consumed in converting the water into steam may be taken as $H_w = 1{,}150 - (t - 32)$ B.t.u. per pound; when t, the room temperature, is 75 deg. F., $H_w = 1{,}107$ B.t.u., or 324 watt-hours per pound of water evaporated. The heat which raises the temperature of the materials being ironed, the ironing board, etc., according to data obtained in these tests, may be closely approximated as $H_m = 0.37\ (0.75\ T - t)$ B.t.u. per pound of materials ironed where T = average soleplate temperature (F) of the iron during the ironing process and t = room temperature (F). For practical purposes, the heat output to these miscellaneous absorbers of heat may be taken as equal to the heat required to raise the materials ironed to a temperature equal to 75 per cent of the average soleplate temperature.

In each of the 103 ironing trials the ironing time, average soleplate temperature, weight of water evaporated, weight of dry goods, energy consumption and soleplate area were measured. The heat absorbed in each trial was then calculated by the method described and is shown graphically in Figs. 2 and 3.

Correlation of Ironing Trials with Calorimeter Tests —The heat absorbed by the goods, ironing board, etc., must obviously be equal to that delivered by the soleplate. The former has been measured in more than 100 ironing trials involving these two standard ironing tasks. The averages of so many results for each of these two tasks can be taken as a reliable measurement of the heat requirements for each and are shown graphically in Figs. 4 and 5. These two curves are designated "ironing duty curves" because they show the rate at which heat must be supplied properly to do two representative ironing jobs. If these two ironing duty curves and the calorimeter curve (Fig. 1) are plotted to the same co-ordinates as in Fig. 6 the intersections between the calorimeter curve and each of the duty curves shows the soleplate temperature and the rate of heat output of that iron when being used on the two standard ironing jobs. From these predicted operating conditions and the total heat curve for the given load (Figs. 2 and 3) it should be possible to predict accurately the ironing time required by the "standard" operator when ironing this standardized load. In other words, given the calorimeter curve of an iron it should be possible from these duty and total heat curves to predict accurately the temperature, rate of heat output and ironing time to be expected under the standard conditions which have been set up as typical. That this can be done with reasonable reliability will be shown with respect to irons 202-E, 206, 213-D and 216-B.

Table I indicates the manner in which these curves may be used in predicting flatiron performance. Comparison of the *actual* values with the *predicted* values shows a maximum difference of only about 10 per cent, which is no greater than the average deviation of a single ironing test from the average and which therefore can be considered a reasonably satisfactory check of the proposed method of predicting iron performance.

As to temperature of operation, it is found that where the iron is operating automatically the predicted temperatures are in close agreement with the actual temperatures. However, in the two cases in which the irons operated non-automatically this agreement in temperatures is not so close; a single test might be in error by

EFFECT OF IDLING TEMPERATURE

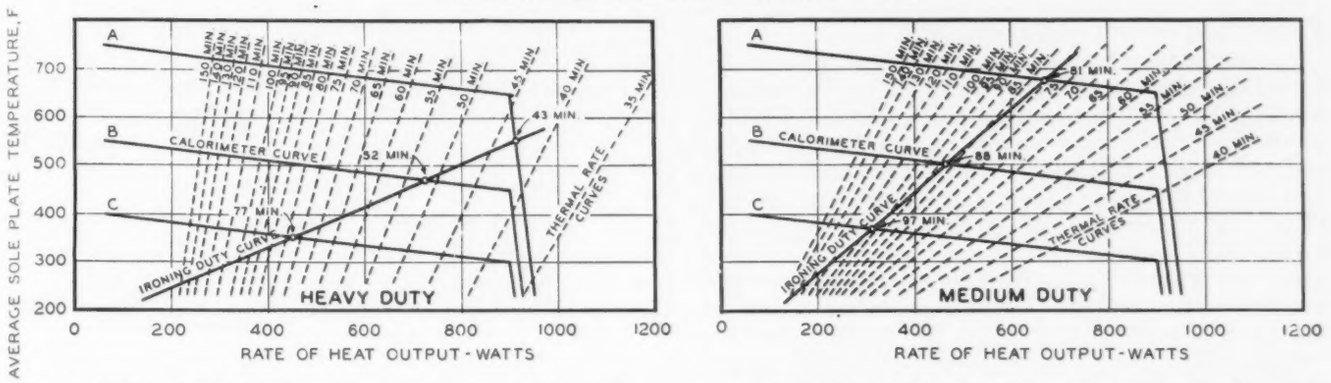


Fig. 9—Effect of Idling Temperature—Since the ironing duty curves slope upward toward the right of the diagram anything which will raise the operating temperature of a given iron will cause it to transfer heat at a more rapid rate and hence, within certain limits, make for more rapid ironing. Assuming an iron with a given temperature control mechanism (which fixes the slope of the calorimeter curve) the higher the idling temperature, or point from which the calorimeter curve starts, the farther the intersections with the ironing duty curves will move to the right and the lower the indicated ironing times will be. In practical ironing this gain is quite marked, but, of course, the limit of the gain is reached when the idling temperature approaches the scorching temperature. Numerous tests have indicated that this idling temperature should *never* be above 650 deg. F., and that for most satisfactory general use the iron should be adjusted to idle on the "high" setting at about 550 deg. F. While a "high" idling setting below this point may be used, it will be at a sacrifice of ironing speed.

EFFECT OF TEMPERATURE CONTROL

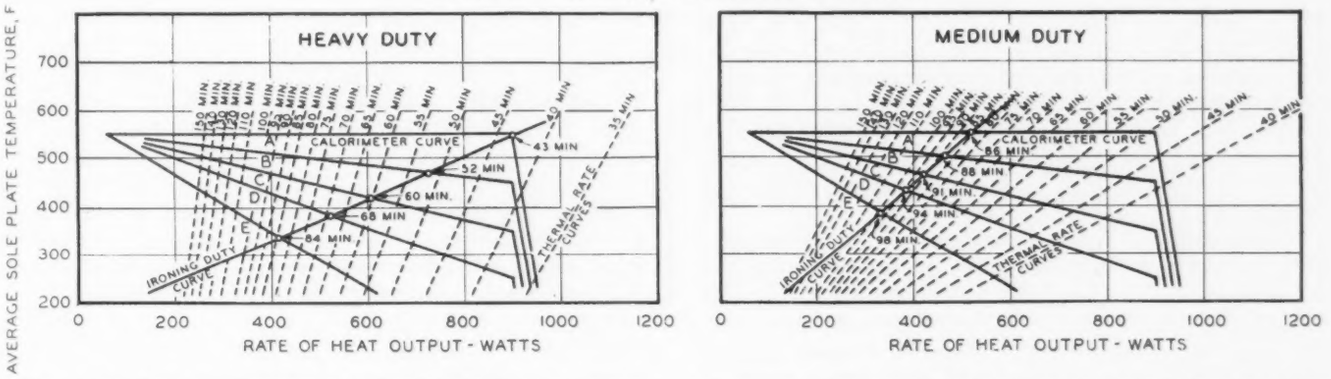


Fig. 10—Effect of Temperature Control—With any given idling temperature, the intersection of the calorimeter and duty curves shows that greater ironing speed is obtained as the temperature control approaches the ideal condition of constant temperature regardless of the load. As the calorimeter curve approaches a horizontal straight line the intersections with the duty curves move toward the right, which indicates more rapid ironing. This suggests that there is a considerable gain in real effectiveness at the the heavier loads to be obtained through improvement in the temperature control of automatic irons.

EFFECT OF SOLE PLATE AREA

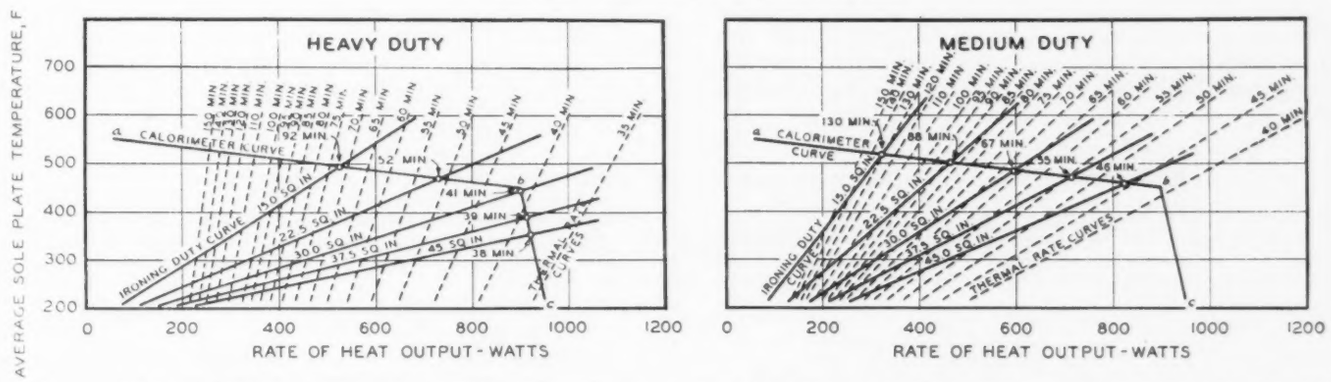


Fig. 11—Effect of Soleplate Area—The ironing duty curves in Figs. 9 and 10 are for a given iron of fixed soleplate area. If the calorimeter curve be fixed for a given group of irons of various soleplate areas it will be found that the intersection of the calorimeter and duty curves is moved in the direction of more rapid ironing as the area of the sole-plate is increased. For ironing at the heavy-duty load it will be noted that while ironing speed is rapidly reduced as the intersections with the calorimeter curve approach the point *b* along the line *a-b*, very little further gain is made beyond that point. In other words, the preferable soleplate area for an iron working on the heavy-duty load is that at which the iron operates close to the point where operation becomes non-automatic.

When the iron is being used on the medium-duty load there is likewise a gain in ironing speed as the soleplate area is increased, but due to the fact that the 1,000-watt iron can hardly be worked to the non-automatic range at this load there is no sharply indicated point beyond which increasing the soleplate area ceases to yield a worth-while advantage in the further reduction of ironing time.

an appreciable amount since, in the non-automatic range, a slight deviation from the average load condition causes a wide variation in temperature (Fig. 6).

Further Application—If the abscissas of the total heat curves of Figs. 2 and 3 be divided by a given value of time, the curve plotted to these new co-ordinates will indicate the relation between the *rate* of heat absorption and the corresponding soleplate temperature necessary to complete that particular ironing task in that period of time. By choosing a number of different time values, families of curves may be obtained indicating the necessary ironing conditions to complete the ironing operation in various fixed times. Such families of curves are shown in Figs. 7 and 8, which will be referred to as "thermal rate curves" for the standard ironing loads.

By plotting the calorimeter and ironing duty curves for an iron on a graph sheet already containing the family of thermal-rate curves for the particular standard load under consideration it is possible to read off directly from the location of the intersection of the calorimeter and duty curves what the probable ironing time will be. This completely eliminates the computation process shown in Table I and gives the value of ironing time directly.

It will be noted that the thermal-rate curves fall in progressive order, the shorter time curves being at the right. Thus for the greatest speed in ironing it is desirable that the intersection of the calorimeter and duty curves fall as far to the right as practicable. Some of the factors controlling this intersection, such as idling temperature, temperature control and soleplate area, are examined and discussed in Figs. 9, 10 and 11. Particular attention is directed to the observations in the subcaptions.

The extent to which soleplate area affects ironing time will, of course, be influenced to some degree by the temperature control. This influence is best shown by plotting the relation between soleplate area and ironing time for a number of different conditions of temperature control (Fig. 12). It will be noted that on the medium-duty load the ironing time is practically unaffected by the slope of the calorimeter curve (effectiveness of temperature control). On the heavy-duty load, however, the influence of the slope of the calorimeter curve is considerably greater up to the non-automatic point. The conclusion suggested, therefore, is that for the medium-duty load the area is limited only by practical consideration irrespective of the slope of the calorimeter curve, while for the heavy-duty load quite definite limits are indicated which depend on the slope of the calorimeter

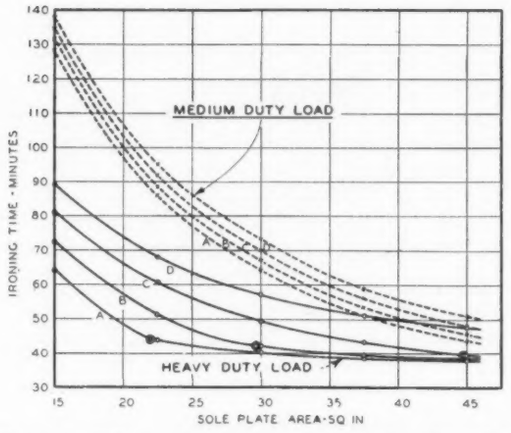


Fig. 12—Effect of soleplate area on ironing time influenced by temperature control

Curves A, B, C and D are based on calorimeter curves in Fig. 10 and hence on effectiveness of temperature control. Calorimeter curves B and C represent the present range of temperature control to be expected in well-designed irons.

curve. The soleplate areas indicated by Fig. 12 as being the maximum consistent with effective gain in ironing time at heavy-duty might be taken as indicating a desirable range of sizes, namely, 25 to 30 sq.in.

It has been contended that an iron with a soleplate area as low as 20 sq.in. is preferable for general use in the home because it is more convenient for "fancy" ironing. There may have been a time when such an argument could be justified, but with the present simplicity in women's wearing apparel this argument hardly seems tenable. Furthermore, such an iron with a 1,000-watt heating element cannot be used at its maximum effectiveness unless adjusted to abnormally high temperatures. For instance, a 20-sq.in. iron must be adjusted to *operate* on the heavy-duty load at 600 deg. F. to obtain maximum effectiveness in ironing. At temperatures below 600 deg. F. it is practically impossible to load the iron to its full capacity in household use.

Conclusions—Applying these studies to the problem of producing the most effective iron from the standpoint of ironing speed, the following conclusions are indicated.

1. When the iron is adjusted at its "high setting" and is being used on heavy loads it should operate at the highest temperature consistent with freedom from danger of scorching. Experience indicates that this temperature corresponds to an idling temperature of 550 deg. F.

2. The temperature control should be designed to hold

Table I—Comparison of Actual and Predicted Operation of Four Flatirons on Heavy-Duty Load

Columns A and G, F and H should be directly comparable.

From Fig. 6 the data corresponding to the points of intersection of the duty and calorimeter curves are recorded in columns A and B, together with indication of automatic or non-automatic operation. Multiplication of figures in columns B and C gives rate of heat output at which iron should operate (column D). From Fig. 2 the total heat energy to complete ironing at soleplate temperature (A) is read and recorded in column E. Dividing the latter by column D gives the ironing time in column F.

	Predicted from Calorimeter Curve						Actual	
Iron No.	Average Soleplate Temp., Deg. F. (A)	Output, Watts Per Sq.In. of Soleplate (B)	Soleplate Area, Sq.In. (C)	Output, Watts (D)	Total Heat to Complete Ironing, Watt-Hours (E)	Time to Complete Ironing, Min. (F)	Average Soleplate Temp., Deg. F. (G)	Time to Complete Ironing Min. (H)
202-E	428 (a)	28.1	21.4	602	612	62	420 (a)	68
							403 (a)	60
206	350 (a)	20.1	24.5	493	586	72	351 (a)	77
213-D	380 (na)	23.0	24.0	552	597	65	417 (na)	65
216-B	461 (na)	31.5	27.0	851	622	44	499 (na)	49

(a) Automatic operation. (na) Non-automatic operation, i.e., thermostat in the "on" position 100 per cent of the time.

the soleplate as nearly as possible at a constant temperature. A drop of 50 to 100 deg. F. from idling to full load is found in irons of the best present-day design.

3. The soleplate should be of such size as to insure most effective use of the full rated input of the iron. The analyses reviewed herein indicate that this size is between about 25 and 30 sq.in.

Simple Tests for Maintaining Relay Reliability

By C. A. MULLER
American Gas & Electric Company, New York

Many good relay installations, properly checked and cut into service, and having all relay settings correctly made, fail to give proper protection when called upon to do so. Although such systems may be perfect when first put into service, wear and tear, dirt, moisture and other causes are bound, in time, to throw some parts out of adjustment. If the trouble is not promptly found and remedied a false operation or complete failure of the relay system, with all its consequences, is bound to result.

Experience has shown that most relay failures are caused by a number of common faults which can be readily found and remedied by making a few simple periodic tests and inspections. This practice, which has been followed on one large system for several years, has proved its worth in keeping relay systems at their maximum efficiency. From this company's experience the most common faults are:

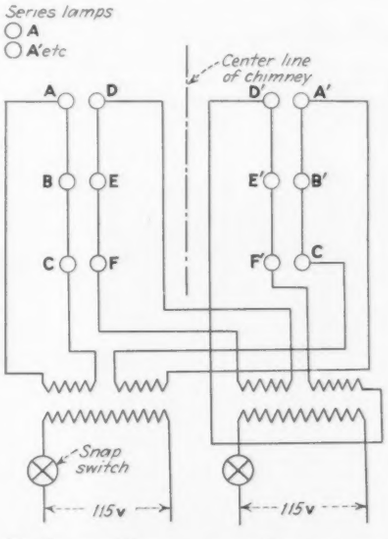
1. Open, grounded or short-circuited bushing current transformer secondary circuits at oil circuit breakers or in power transformers.
2. Loss of potential in potential circuits from blown fuses or disconnected leads at potential transformers.
3. Open current, potential or trip circuits in switch parts inside test switches. (Especially in test switches of older types.)
4. Open current, potential or trip circuits due to loose connections on test switches and terminal blocks.
5. Open current circuits due to open or loose current links.
6. Low d.c. battery voltages after severe duty cycles on batteries. This is especially a cause of trouble in the case of 12- and 24-volt battery installations used for tripping service only.
7. D.c. control bus grounds.
8. Mechanical troubles in trip-coil mechanisms due to changed adjustment of trip-coil plunger.
9. Disks binding or fouling in induction type reverse power relays from improperly fitted covers.
10. Improper action of plunger-type interlocking relays on account of changed adjustment of bellows and latch mechanism.
11. Improper operation of auxiliary switches in oil circuit breakers.
12. Binding of disks in induction-type relays from defective jewel bearings and pivots, presence of foreign material, etc.
13. Open circuits, grounds or short-circuited turns in relay coils.
14. Burned, pitted or improperly adjusted relay contacts.

The presence of any of the above troubles can be discovered from the results of the following simple tests, which should be made at least monthly. It is important, to be sure of discovering trouble caused by test switches, to make the first three tests before operating any test switches.

1. Trip oil circuit breakers from all tripping relays.
2. Place ammeter across the current studs of induction-type overcurrent relays and remove current plugs of relays to see whether current readings in all three phases are approximately equal.
3. Place ammeter in series with current coils of induction-type reverse power relays by removing links to see whether current readings are approximately equal in all three phases.
4. Measure voltage on all potential relays, at the relay potential coil studs, with a voltmeter.
5. Measure tripping battery voltage on open circuit and during tripping of one oil circuit breaker.
6. Test d.c. control bus for grounds by means of a d.c. voltmeter or ground lamps.
7. Check operation of plunger-type interlocking relays to see that they operate positively.
8. Operate test switch on differential ammeter for checking unbalance of transformer or bus differential relays to see that the readings for the three relays are approximately equal and do not exceed the allowable amounts for peak-load conditions.
9. Operate test switches on induction-type reverse power relays and see that, with cover on, the disk is free to rotate.
10. Inspect visually all relays, with covers off, to make sure that the relay is in satisfactory operating condition. Especially check free rotation of disks, free travel of plungers and proper operation of toggles and see that contacts are properly spaced and not burned or pitted.

Series Lamps Safeguard Aviators Near Stack

To safeguard aviators in the vicinity of its 180-ft. brick chimney at the new Buzzard Point steam plant in Washington, D. C., the Potomac Electric Power Company has equipped the stack with six pairs of 6.6-amp. series lamps connected in four circuits of three lamps each and mounted in clear inclosing globes one-third up, two-thirds up and at the top of the chimney. There are three pairs located on each of two sides of the stack and the supporting brackets are within easy reach of the two outside maintenance ladders which extend from top to bottom. Replacement is effected by the use of the safety belt, no cage having been thought necessary at present. Each of the four circuits is supplied with energy from a secondary of a small constant-potential transformer of the double-secondary type, which insures that if one secondary fails the other will continue to supply energy to one side of the stack. The stack is under close observation by the operating force.



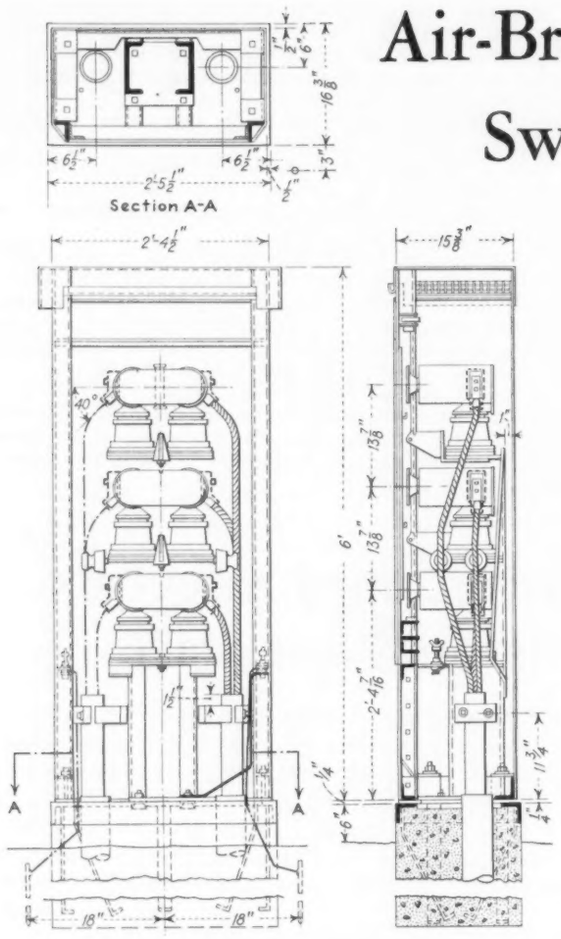
Each transformer supplies one set of lamps on opposite sides of the stack

One transformer is switched into circuit on one night and the other the next evening, so that one lamp of each pair on each side is in service every other night. About 25 per cent longer lamp life is assured by the use of series units.

Air-Break Sectionalizing Switches for Ring Primary

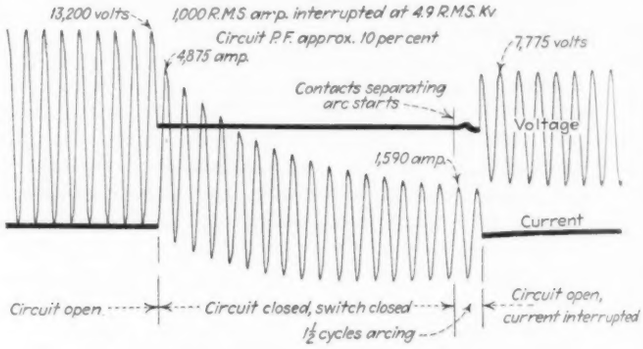
By C. A. MATTHEWS
Inspection and Equipment Engineer, Detroit Edison Company, Detroit, Mich.

Load-breaking, hand-operated, single-pole, Deïon air-break switches are used to sectionalize the three-phase, 4.8-kv. underground cable ring feeders supplying the secondary a.c. network of the Detroit Edison Company. These switches were developed in the company and built by the Westinghouse Electric & Manufacturing Com-



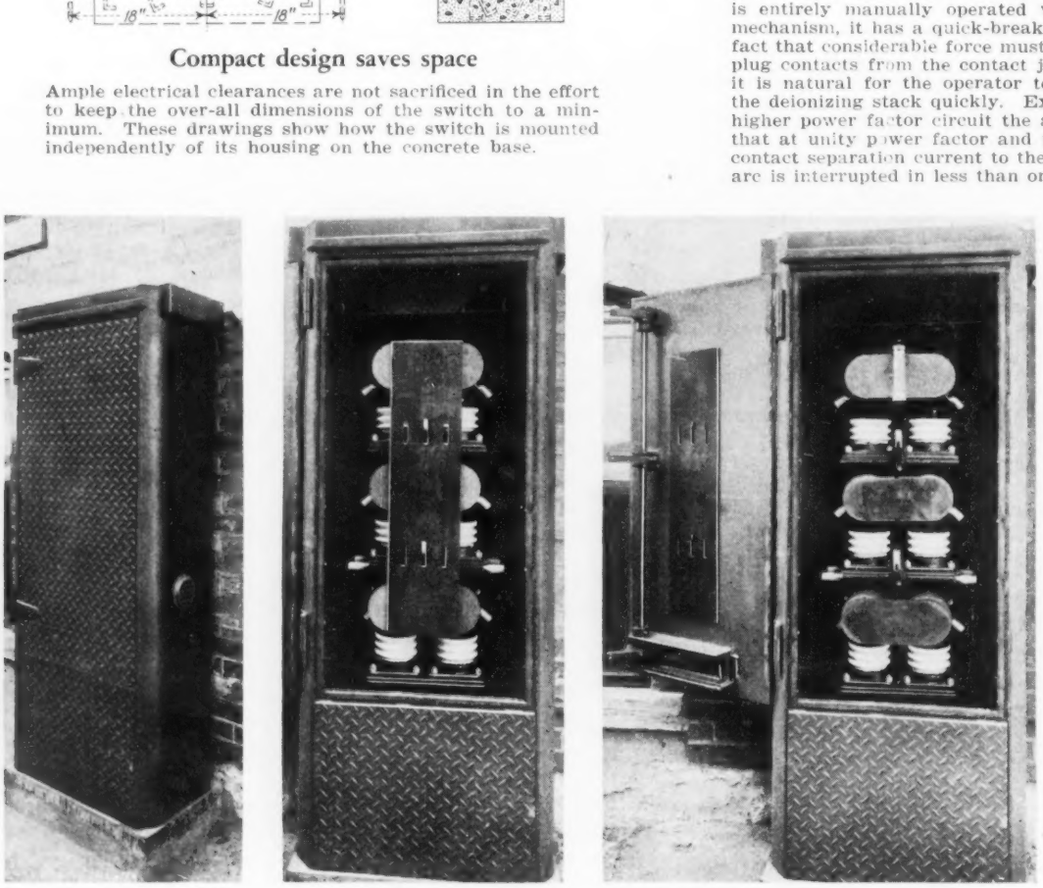
Compact design saves space

Ample electrical clearances are not sacrificed in the effort to keep the over-all dimensions of the switch to a minimum. These drawings show how the switch is mounted independently of its housing on the concrete base.



Break normally in two cycle

A fast stroke is not essential. Even though the switch is entirely manually operated without any quick-break mechanism, it has a quick-break characteristic due to the fact that considerable force must be exerted to release the plug contacts from the contact jaws, with the result that it is natural for the operator to pull the plugs through the deionizing stack quickly. Experience shows that in a higher power factor circuit the arcing time is reduced so that at unity power factor and normal stroke velocity of contact separation current to the value of 600 amp. in the arc is interrupted in less than one cycle.



Deïon disconnecting switch

At the left is the closed cubicle. In the center may be seen an insulator masking plate hung on the front of the switch as a protective measure. At the right the mask plate has been removed and the operating handle is shown attached to the top unit. The handle was made removable in order to save space on the front of the switch. The switch consists of three single-phase units, each unit having two deionizing stacks arranged horizontally. The phase units are thus spaced vertically. The deionizing stacks contain helices for rotating the arc within the gap between deionizing plates. Draw-out parts consist of copper with a circular-arc cross-section formed into a square-cornered U. The contacts are plug type. The main contact, when the switch is closed, is about 1 in. from the tip of the plug, and since the arc of opening occurs at the tip of the plug, the current-carrying contact is not affected by pitting.

pany. They are rated 7,500 volts, 400 amp. and have an interrupting capacity of 600 amp. at 5,000 volts. By their use a section of the cable ring feeder can be switched out of service and worked upon without shutting down the entire line. The construction, operation and interrupting performance characteristics are apparent from the accompanying illustrations and captions.

The switches are housed in cubicles of neat design which can be located in public alleys. The cubicle is made of heavy welded steel plates which have sufficient strength to withstand the bumps from carelessly driven vehicles. Its door is of the flush type without protruding handles which might be knocked off. Ventilation is provided to reduce condensation. The switch is mounted on a pedestal which is independent of the housing, hence shocks received by the cubicle are not transmitted to the switch. The whole installation takes only 16 in. of the alley's width, which is about that required for poles.

The main advantages of this switch are: (1) Since there is no oil, the hazards of fire and explosion are eliminated, (2) the break is visible and (3) the contacts are easily accessible for testing and maintenance. The cost and space required are at least comparable with other equipment available to perform the same service.

Area Charge Beneficial to the Customer

To meet the query as to how the so-called area charge can be justified on domestic bills where a customer pays twice as much for lighting a large room as a medium one, although consuming the same amount of electricity, President Samuel Ferguson of the Hartford Electric Light Company recently presented the following:

"I cannot only justify the charge as equitable, based on our costs, but can demonstrate conclusively that through this method of billing the customers of the Hartford company have benefited tremendously as compared with customers in other sections of the country where the method has not been used. We have ample data that must be convincing to any one who will study it. A few of the salient facts are:

1. The simultaneous use of light decreed by nature after sunset makes electricity as normally used about twice as expensive as when used for power.

2. As a result it used to be the universal practice in both private and municipal plants to require customers to wire their houses with a lighting circuit on which a lighting price was paid, and if they wanted to use cheaper power also, to install a second circuit for this purpose.

3. This was what we did in 1921, then charging in the home 10 cents for light and 4 cents for power on a separate meter. But as few people would pay the cost of installing a separate circuit, the result was practically a universal 10-cent price.

4. This price, then necessary for light, was far too high to allow of other uses; the housewife might have an electric iron, but it was used only for laces, ruffles, etc., and not for the family wash, so the problem was how to make a power price available at every socket in every home without the customer's having to meet the cost of rewiring.

5. It was found by study of 2,500 homes of various sizes that the ordinary use of light varied very uniformly with the size of the house. You would say that was not much of a discovery, because if one lamp will light one room, it will naturally take two lamps to light two rooms, but, nevertheless, it was the key to lower rates because of the discovery that for a minimum of reasonable lighting an average of 2.5 kw.-hr. is required per month for every 100 sq.ft. to be lighted.

6. Obviously, then, if we charge the lighting price for the first 25 kw.-hr. that is required for light in a 1,000-sq.ft. house, and a power price for all excess, we would accomplish the desired result of giving a lower price for all use over that required for a minimum of lighting service. Similarly, in a 2,000-sq.ft. house, 50 kw.-hr. is what a separate light meter would register as the amount which should be billed at a lighting price.

7. Owing to the fact that in 1921 every one thought in terms of the high 10-cent price, it was necessary, if electricity were to be generally used, to erase this 10-cent figure from their minds and to leave there only the lower power figure which truly represented the cost of all additional use they wished to make.

8. This has been accomplished by billing all energy, whether used for light or power, at the lower power price, and adding to this power price a surcharge of such an amount that it, plus the power charge, will amount to a proper lighting figure for such energy as is used for light. Because less light is used in a small than in a large house, it was only fair to those who live in small houses to make this surcharge less than for a larger house.

"As a result, the essential minimum lighting requirements of small or large houses work out to be at exactly the same rate, and each also obtains its power at the same power rate. For example, take two houses of 1,000 and 2,000 sq.ft., each using 50 kw.-hr. for power

Area Charge Stimulates Higher Residential Uses

	Kw.-Hr. Domestic Use per Customer Per Year 1932
Duquesne Light Company (Pittsburgh)	756
Hartford Electric Light Company	750
Niagara Hudson Power Corporation (Albany)	**705**
Connecticut Power Company	700
Connecticut Electric Service Company System (Waterbury)	640
Philadelphia Electric Company System	630
West Penn Electric Company Subsidiaries (Butler)	620
Central Hudson Gas & Electric Corporation (Poughkeepsie)	610
N. Y. State Electric & Gas Corp. Group (Assoc. G. & E. System)	600
Western Massachusetts Companies System (Springfield)	595
Long Island Lighting Company System (Queensborough)	587
Edison Electric Illuminating Company of Boston	585
Jersey Central Power & Light Company (Asbury Park)	578
Rochester Gas & Electric Corporation Group	570
Staten Island Edison Corporation	563
Pennsylvania Power Company (Newcastle)	562
Penn Central Light & Power Company (Altoona)	554
Bangor Hydro-Electric Company	545
Atlantic City Electric Company	541
United Illuminating Company (New Haven)	535
Cumberland County Power & Light Company (Portland)	535
Assoc. Gas & Electric System (Eastern Penn. & N. J. Group) (Reading)	515
Assoc. Gas & Electric System (West Penn Group) (Johnstown)	495
Central Maine Power Company System (Lewiston)	485
Pennsylvania Power & Light Company	485
Public Service Company of New Hampshire	465
New England Power Association System (Worcester)	460
Scranton Electric Company	448
New York Edison System	440
Luzerne County Gas & Electric Corporation	423
Public Service Electric & Gas Company (N. J.)	395
Blackstone Valley Gas & Electric Company	**380**
New Bedford Gas & Edison Light Company	**360**

or light in excess of the energy necessary for its minimum lighting requirements.

"In the smaller house the area charge of 80 cents plus the power price of 4 cents for the 20 kw.-hr. used for light makes a total charge of $1.60, or 8 cents per kw.-hr. for lighting. The 50 additional kw.-hr. are at the 3-cent power rate, as is any more which might be used.

"In the larger house the area charge of $1.60 plus the power price of 4 cents for the 40-kw.-hr. used for light makes a total charge of $3.20, or again 8 cents per kw.-hr., and again the additional 50 kw.-hr. is furnished for 3 cents each.

"The flat charge is not something for nothing, but it is the fee paid for the privilege of having the light billed at a 4-cent power price instead of at a reasonable lighting price which would be twice as much.

"When we introduced the area charge we reduced the meter price from 10 cents to 6 cents per kw.-hr. at the same time. The net result of this move was a reduction in our income of $100,000, but this was quickly made up by reason of the increased use our customers made of 6-cent electricity. This increased use lowered our costs, and we gradually came down to the present rate, which is a fixed charge of 80 cents per 1,000 sq.ft. plus 4 cents for 20 kw.-hr. per 1,000 sq.ft., with all excess above those few kilowatt-hours billed at 3 cents.

"This rate brings very equitable results on the usage of any twelve-month period, although, of course, there are occasional cases that look like rank injustice, such as when a house is closed for most of a month, etc., but on the whole customers get more for their money under this system here than in most places in the country, and nowhere has there been such a percentage drop in price in the last ten years as in Hartford. Of 33 leading Eastern systems whose domestic energy consumed per residential customer in 1932 ranged from 360 kw.-hr. to 756, Hartford with the latter figure led the list.

"The noteworthy point about this list is that the five companies which top this list and give the most service to their customers have each in their rate schedules some form of an area or room charge. At the bottom of the list are those companies which try to sell electric service as they would sugar or beans at a uniform commodity price, or graduated only as to quantity."

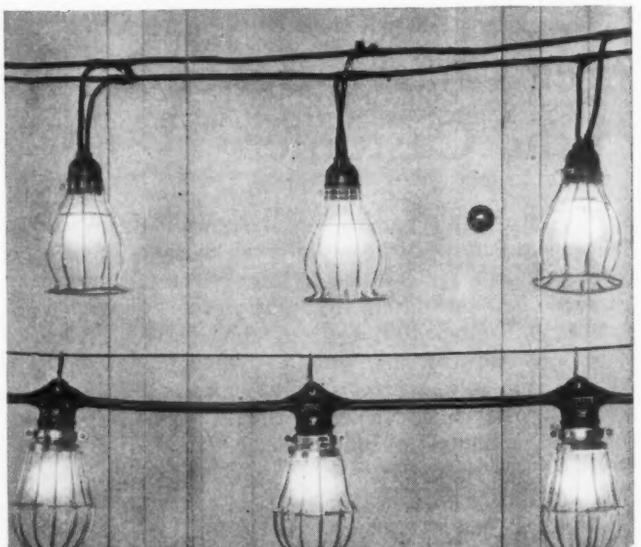
Safety, Economy, Speed in Temporary Lighting Jobs

By H. V. HARDING
Detroit Edison Company

Old, wasteful and often dangerous methods of temporarily lighting construction jobs have been discarded by the construction bureau of the Detroit Edison Company since the development of a lighting unit known as the Harding safety cord. This stringer lighting cord is made from a standard portable rubber-clad extension cord in lengths of approximately 60 ft. At intervals of 10 ft. the cord is opened and, in a special machine designed for the purpose, rubber sockets are molded to and become a part of the cord by vulcanization, making a complete unit of the whole. Each socket has an eyelet molded into the top from which the cord can be suspended. It lends itself to suspension from messenger wire, nails or any other convenient means. The neck of the socket is made long enough to press on the neck of the lamp, which gives the unit the added advantage of being weatherproof in the true sense of the word. It has been used successfully under water.

In lighting up a job gang plugs are installed and the stringers plugged in and suspended over the work. When the job is completed they are coiled up and returned to the tool room, where they are stocked as a standard tool, ready for service at any time. Some cords have had severe service over a period of three years without showing signs of wear or deterioration.

Where floodlighting is not practicable the disadvantages of the ordinary methods of temporary lighting are well known to all who have had to use weatherproof sockets and rubber and braid wire, taped joints and knobs. Broken wires and sockets, frayed insulation and tape, grounds, short circuits and broken knobs are common troubles, with their attendant hazards to life and property. The salvage value of this type of wiring is very low. Lack of portability is one of its drawbacks. Attempts to change temporary lighting wires to accommodate various stages of construction, especially where false work is being erected or torn down, cause most of the trouble, and with trouble comes higher maintenance costs.



Permanent cord for temporary lighting

At the top is shown the usual way of stringing temporary lighting, not very safe nor very long lived. Below is the Harding safety cord, perfectly safe and capable of being used over and over again.

The new safety cord has eliminated all of these disadvantages, has given flexibility to all types of temporary lighting, has eliminated lost time arising from outage of careless temporary wiring, thus successfully meeting the three important factors to be considered, namely, safety, economy and speed of installation. Undoubtedly it is a help toward better temporary lighting and reduced construction costs.

Gradual Rural Electrification

Vast market for service awaits sound development
Urban and rural interests should not be separated

By H. P. LIVERSIDGE*
Vice-President and General Manager Philadelphia Electric Company

THE longer one studies the relationship between the farm and electric utility service the more definitely he becomes involved in a tri-party problem, embracing the electric utility, the equipment manufacturer and the farmer. Even in the light of the most searching scrutiny, no serious criticism can be directed toward any one of the three interests because of what may seem an unnecessarily slow rate of progress. I am certainly not in sympathy with those critics who seem unnecessarily swayed by a feverish desire to rush farm electrification in the hope of achieving an economic miracle, leading quickly to the greatly-to-be-desired agricultural prosperity. Fortunately the farmer represents a most stable element of our society and will not be rushed headlong into obligations which do not offer reasonable opportunity of economic success.

In the farming operation itself the number of uses to which electricity may be put is steadily increasing and now exceeds 200. It has become almost indispensable to many of the vital phases of farm operation, notably in poultry raising and dairying. The proportion of time and labor saved by electric milking alone runs from 55 to 95 per cent. Notwithstanding the wide variety of utilization equipment available, the present estimated degree of saturation for the various pieces of equipment is on the whole startlingly low, with the exception of electric pumps (40 per cent). Cream separators follow at 14 per cent; milking machines, 11 per cent; general purpose motors, 8 per cent, and incubators, 4 per cent. All indicate the vast future market for electrical farm apparatus. To appreciate fully how low are these saturations, it should be noted that in the general domestic field such appliances as irons, vacuum cleaners and washers have an estimated saturation nationally of 98, 47 and 40 per cent respectively.

One reason for this relatively low saturation of electrical farm equipment is that only within the past few years has an appreciably wide range of reliable and moderately priced equipment been available. The motor-driven equipment of a decade ago, as well as dairy equipment, is inadequate in comparison with present developments. Had the average small farmer then invested in such equipment, he would now find that in order to compete with his neighbor's more modern installation his investment would in all likelihood have to be discarded and modern apparatus purchased. In the earlier period of rural electrification only the larger or more successful farms were in a position to assume the risks of such investments. These benefited to such an extent that with the development of improved appliances they were able to discard the old and replace it with the new, unconsciously contributing largely toward the perfection of such devices.

From a paper before the American Association for the Advancement of Science at Boston, Mass.

Present status of farm electrification

In the average rural area only 15 to 25 per cent of the homes represent farms as defined by the Census Bureau. From the utility's standpoint the problems involved in serving rural areas are quite similar for all types of rural customers except that there is a broader field for the application of electricity on the farm than in the country home or rural commercial establishment. It is estimated that in 1932 about 1,000,000 farms in this country were electrified, more than 70 per cent being served by electric utilities. The estimated total customers served in rural districts was 4,000,000. While such figures are encouraging, it is apparent that our rural sections are lagging far behind the rest in electrical comforts and advantages. Almost one-third of the country's total population is without electric service, and most of these people live on farms. In other words, about 95 per cent of the families in urban communities have electrical central-station service compared with 30 per cent of the remaining population. Electric service at present extends to 60 per cent of the village population, while only 11 per cent of the farm population is reached by utility service.

In most states there are at least three times as many farms using stationary engine power as are using electric motors. According to the U. S. Department of Agriculture Bulletin No. 1348, the average cost to the farmer of the miscellaneous array of power he uses is about 19 cents per horsepower-hour. The bulletin further states that the central-station farm customer can buy a horsepower-hour from the average small utility for 15 cents and from the larger system for 5 cents. Many farms that are not at present electrified or connected to central-station lines are awaiting an economic recovery which will open up a market of almost $1,500,000,000 of additional electrical equipment, estimated to require energy of the order of 4,000,000,000 kw.-hr. annually. Electrical manufacturers, jobbers, dealers and utility men are all vitally interested in getting suitable electrically operated equipment into the hands of the farmer. Today about 1,000 trained central-station rural electrification engineers are devoting their time to utility

load building on existing rural lines. The results of such efforts are becoming evident, although there is much opportunity for accelerated growth.

The growth of rural electric service rests largely on the volume of business than can be obtained through increased industrial application on the farm. This, in large measure, gives the answer to the economic extension of utility distribution facilities and offers the greatest opportunity for reduction in the average unit cost of service to a basis comparable with the rates in urban centers.

Basis for developing fringe areas

It has always been recognized that a part of the territory of each electric service company consists of what may be called its fringe area. The density of business in such area is less than in the center of town. It generally has been deemed sound practice to extend service into these areas of less than average density on the basis that the revenue to be secured would carry the investment in the extension, so that rates would not have to be raised to the customers residing in the more densely populated areas. In other words, these customers are added on the basis that they shall pay the increment costs of providing service to them from a system already operating on a sound economic basis. In time these fringe areas grow more populous so that their density approximates the built-up section and newly developing territory takes on the character of fringe area.

There has always been a conflict of views on this point. The customer in the built-up section feels that the outlying customer should pay his full proportionate share of the total cost of service, including the cost of his particular extension. On the other hand, the electric utility is able to effect economies by building up the volume of its total available business, and the fringe area customers are a contributing factor in this growth. The consequent effect is to lower average costs so that from time to time rates may be reduced to the benefit of all.

In the case of Pennsylvania, which had a farm income of $250,000,000 in 1931, early discussions of the general problem of rural electrification by a committee representing the agricultural and utility interests resulted in the promulgation of a general order by the Public Service Commission. This as revised stipulates that the utility shall bear the cost of building and maintaining the rural lines along the highway and shall extend service anywhere within its chartered territory provided it is guaranteed a monthly revenue based on the over-all cost of the extension. The guarantee, which now ranges from $1\frac{1}{2}$ to $1\frac{3}{4}$ per cent per month of the cost of the line extension, is apportioned among the several customers using the extension on a basis mutually agreed upon and is adjusted as additional customers are connected to the line. Each customer is permitted to use electricity at the rates in effect in the nearest municipality up to the amount of his guarantee without additional payment. Thus relieved of contributing any part of the original construction cost of the line, the farmer or rural customer has just that much more money available with which to purchase electrical appliances and equipment.

As a consequence, during the past six years in Pennsylvania we have had under way an active organized program of rural electrification in which the electrical industry (including both manufacturers and utilities) and the agricultural industry have actively co-operated in promoting the extension and use of electricity. During that time the electric utilities have spent approximately $16,000,000 for extending service to 90,000 rural customers, of whom 23,000 are farmers. Only one of every four of the customers on rural lines in Pennsylvania is a farmer. This ratio probably holds true for a great part of eastern United States, so in discussing rural electrification it is not sufficient merely to consider farm service; it is the rural community as a whole which must be considered.

Too rapid extension of rural lines uneconomic

How rapidly rural electrical development can or should take place is most important. No one would question the social satisfaction of having an improved road to every rural home, but after a century or more of development of our main arteries of travel the people have not felt justified—nor have they been willing to supply the money necessary—in producing such roads when they were called on to pay the resultant tax. Surely no one would question the ultimate desirability of having electric service available to every home and farm in the land. But are the people to be served yet ready or able to make sufficient use of the electricity to justify the cost of furnishing and maintaining the service?

This question raises a major issue that for a long time has confronted electric utilities in the development of domestic service even in the most populous areas. Exactly the same issue confronts us in the development of rural areas. We know, for example, that the national average of domestic electrical consumption is in the order of 604 kw.-hr., whereas only a small percentage of homes average more than 3,000 kw.-hr. annually. Numerous examples may be cited where the use in rural areas, after several years of electric utility service, is still appreciably below the minimum guarantee. There is no evidence here to indicate that electric rates are a deterrent to greater use. The real difficulty lies in the customers' ability to purchase the additional apparatus required. One might pass lightly over this with the obvious suggestion that utilization equipment be radically reduced in price. As a utility operator, nothing would please me more than to see this accomplished. But manufacturers' records apparently indicate little or no profit, while in many lines they have experienced actual losses. Probably one reason for this is that nearly every manufacturer has made extensive changes in his product to improve reliability, economy of use and adaptability. Thus we may readily conclude that at least from the standpoint of some types of electrical apparatus we are still in the early stages of a new and rapidly changing art.

Thus far the policy in the United States, regardless of the particular plan of rural extension, has been based almost entirely on the assumption or agreement that the customer would use sufficient service to justify its extension. If this policy is continued, the expansion of rural service will follow somewhat the course of other developments, thereby insuring a healthy growth over a reasonable period of time. There is a natural hesitation to spend money for something new among rural people, even though convenience or production facilities are increased. To overcome this reluctance to change requires gradual education, and this process, like all educational activities, cannot be rushed unduly without serious economic loss.

Of one thing I am absolutely convinced. The greatest

error we could make would be an impetuous plunge into a national program of complete electrification of the rural and agricultural areas. We may look forward with confidence to the day when electric service will be available in every area on a scale comparable to that which practically every urban user now enjoys. Yet no matter what immediate stimulus might be given this agricultural program, I am certain that a too-rapid development would lead to economic conditions in which not only the farmer would suffer but many others as well.

Science and engineering are continually evolving new and improved solutions in the field of utilization and distribution. These developments alone offer promise of stimulating greatly our future expansion. As an example, recent experimental work with vacuum tubes points to the possibility of a simple, flexible system of distribution which may open the way to the economic supply of sparsely settled agricultural areas that today cannot be reached without an unwarranted investment in distribution facilities. We should always strive to be in a position to take full advantage of new developments, aggressively pushing along lines which can be justified economically. There is a growing appreciation by the farmer of the advantages and economies of electric service in farm work. This undoubtedly will be cumulative, and I believe the electric supply companies and the manufacturers are fully aware of their responsibility to keep abreast of the farmer's changing attitude and increasing demand.

Segregating urban and rural systems retards rural electrification

Any tendency toward municipal ownership which would segregate the urban from the rural systems of the utilities must react unfavorably upon the farmer and dim the prospects of further progress toward rural electrification. This would result in unfair discrimination, and any such territorial division of service would be nothing short of anti-social. It would stop, or at least hamper, progressive rate reduction by central stations in combination urban and rural areas. The farmers themselves are opposed to such measure, as instanced in the action of the Pennsylvania State Grange in December, 1933, at its annual meeting in Johnstown, where it passed the following resolutions:

RESOLVED—That we call upon local, state and national agencies in formulating and carrying out our policies dealing with electric service to recognize that there is a mutual interdependence between the farmer and the townsmen, so that the present-day electric service area unit must include city, town and country in order to serve best the public interest socially and economically.

Therefore, we are opposed to any measures under which the town or city would be taken out of this electric service area unit, thus leaving the country district by itself and placing the rural people in a position where it would be impossible to secure extension and maintenance of electric service on a favorable basis. We commend the present policy of uniform rates in the town and country for the same class of service.

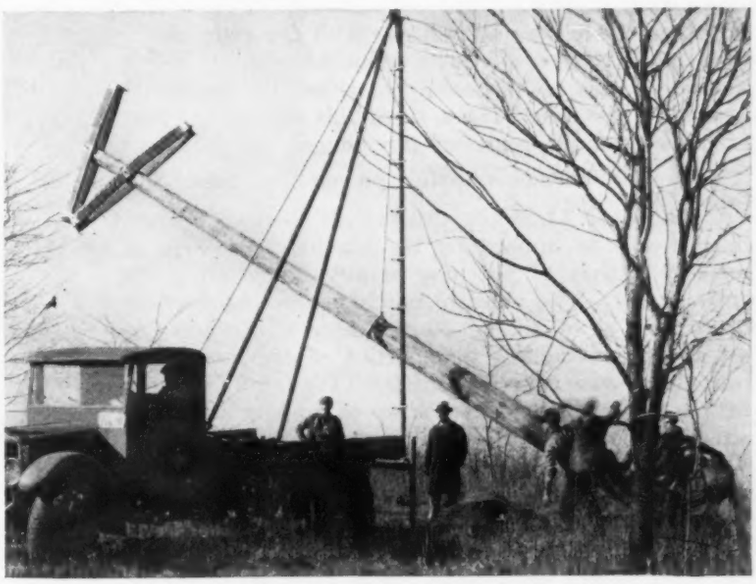
The farmer is in no frame of mind today to tolerate any arbitrary or dictatorial policies, based on the mistaken promise of helping the urban citizen, when such action results in downright injury to himself. It is my belief that the proponents of such uneconomic developments, be they used as yardsticks or what not, are short-sighted, and I would expect the great, stable, sound and clear-thinking part of this nation's citizenry to be heard from in no uncertain terms when this development, which is now so confidently painted in roseate hues, is presented in its true color.

Engineering developments are slowly but surely reducing the investment cost of service. Yet any appreciable future reductions in cost of service depend primarily upon securing additional customers on existing lines and increasing the consumption of present customers. Progress toward this dual objective may be accelerated, even in the face of certain limitations, by aggressive merchandising and adequate financing facilities. The task will demand the maximum co-operation of the equipment manufacturers, the power utilities and the farmers themselves.

T.V.A. Starts Rural Work

Field work on the first rural electrification trial area of the Tennessee Valley Authority has been under way in northeastern Mississippi for about a month. T.V.A. is furnishing part of the materials, the engineering and the construction equipment needed. The rest of the materials and the labor are being supplied by the local community. Relief-roll labor is largely being employed. Substantial design has been adopted for all features of the project. Every effort has been made, however, to adapt the design to the local conditions and to the needs of the service to be rendered. To this end, various features uncommon to this class of pole-line work have been included in the design.

With the rate schedules adopted by the T.V.A. for rural service, and the plan of providing appliances to consumers under the Home and Farm Electric Authority project, T.V.A. is understood to consider that the demonstration area now being electrified in Mississippi will very soon prove the practicability of its policies in this direction.



Pole carrying special crossarm design being erected for Mississippi rural electrification

Gas Competition Prompts Trial Range Plan

By M. T. ANTHONY
Sales Manager Western Public Service Company, Scottsbluff, Neb.

DURING the past six years we have built up an average electric range saturation of 22 per cent throughout our territory, which is comprised of 130 small towns. Since the first of this year, however, not only have our range sales dropped off to almost nothing, but we have been forced either to repossess or to disconnect ranges at an alarming rate. The cause—natural gas competition, aided by economic conditions. Last spring the success which several Eastern companies were having in renting electric ranges was brought to our attention. At that time it was particularly interesting to us on account of its possible application to our own range situation.

In some sections of the territory natural gas is being sold at a 50-cent top rate; in other sections at a 70-cent top. Our electric cooking rate averages 3¼ cents. This means that a customer may cook with gas for $1 to $1.50 a month, as compared to $4 to $6 with electricity. Our high saturation indicates that a thorough educational job has been done in the past on electric cookery and this leads us to believe that we could hold this business in spite of competition if it were not for adverse economic conditions. In fact, it is interesting to note in nearly every case wherein we have lost an electric range user that the customer has expressed regret at being compelled to change from electric cooking to some other method and has stated that, when conditions permit, electricity would again be used for cooking purposes. This indicates that the situation is purely economic.

In June we decided to experiment with a range-rental plan, using three key towns as a proving ground. In one of these towns we had no gas competition, in the two others there was natural gas with top rates of 50 cents and 70 cents respectively. Our main object in this experiment was to dispose of our rapidly increasing stock of repossessed ranges. For this reason the plan did not include the rental of new ranges.

Monthly payments applied on purchase price

A charge of $1.50 per month was made as rental, which would be applied on the purchase price if the customer wished to purchase at any time during the rental period. The ultimate purchase price of a range was arrived at by adding 20 per cent to its storeroom cost and to this adding that portion of the installation cost which was not capitalized. (We capitalize that portion of the wiring expense up to and including the meter loop.)

For several months we placed a great deal of effort behind this activity, using every available medium for giving it publicity. The results were very disappointing. In those towns having gas competition 60 per cent of the rental ranges were taken out after being in operation two months. In the town having no gas competition only a small quantity of ranges were rented. None of these have been returned, however, and it is interesting to note that several new ranges were sold outright as a result of the publicity that was given the rental plan.

This experiment has been valuable to us in obtaining the following facts:

1. That until the financial status of our customers improves it is economically wrong to expect any great increase in electric cooking load in natural gas territory, and that our greatest efforts should be confined to those sections having no natural gas service.

2. That new ranges should be used instead of used ones. This will create a greater incentive for ultimate ownership on the part of the customer.

3. That only one model range should be selected and used exclusively for rental purposes.

4. That rather than attain the ultimate purchase price through small monthly rental payments, the customer should be given a certain period in which to rent the range for trial, after which the range would be sold to the customer on extremely low monthly payments. Realizing the need for an immediate increase in load, we have formulated a plan incorporating these points. Instead of being called a "Rental Plan," it will be known as a "Trial Plan."

Range to Be Used—We have selected a gray porcelain range equipped with four open coil burners. It has a 16-in. oven with automatic temperature control.

Trial Period—These ranges will be installed on trial for a period of six months at a monthly charge of $1.50. The expiration of the six-month period will serve as an opening in which to attempt the closing of the sale. If the customer does not wish to purchase at the end of the trial period, the trial may be extended for another six-month period.

Purchase—The monthly rentals apply toward the purchase price of the range only when and if the customer finally agrees to purchase the range. At that time a trade-in allowance will be made on the old equipment and a special inducement of 10 per cent discount will be given for cash. The time price will extend over a period not to exceed 24 months. Price of $99.50 will include installation.

Service—Ranges will be serviced free of charge during the trial period and for a period of 24 months after date of purchase, providing total free service period does not exceed 36 months.

Dealer Co-operation—Dealers who agree to display this range will receive a commission of $10 for each acceptable trial contract they turn in, payable in five monthly payments. Dealers who do not display the range will receive $5 for each trial payable in five monthly payments. If a range does not remain on trial for six months with regular payments made, commission will then be charged back to dealer.

With this trial plan, we believe that within a comparatively short time we will be able to do a load-building job which would normally require several years by usual selling methods. It will also enable many people to enjoy the advantages of electric cooking who formerly could not afford to pay for both the monthly consumption and high installment payment on the equipment.

South and West Show Year-End Gains Over 1932

Southern industry slackened slightly in its rate of activity in December compared with November, according to monthly reports of energy consumption received by ELECTRICAL WORLD, but the decrease was smaller than in 1932. Whereas the revised figures for November showed an increase of 8 per cent in the general average over last year, in December the margin rose to 15 per cent.

There was, however, some shifting of the balance as to the various industry groups. Thus textiles, after several months at a level about 20 per cent above the 1923-1925 base and well above 1932, dropped 12 per cent to the same rate as a year ago.

The stone group, on the contrary, after dropping in October to half the July figure, reversed its movement, rose sharply in November and in December made up the rest of the loss. Late returns for the former month revealed strong gains, particularly in Texas and Tennessee, not previously indicated. Important progress continues in iron and steel, with a new upward turn in metal-working industries.

In the West the general average of November was maintained, with a gain of 24 per cent over 1932, bringing the highest December since 1929. Recovery has restored the level during the second half of 1933 approximately to that prevailing in the spring of 1931.

Further progress in the metals and firmness in the stone group doubled both index numbers over 1932.

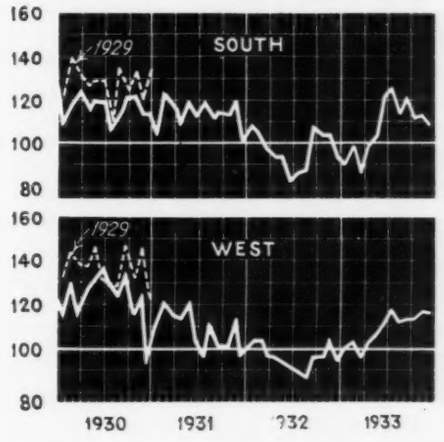
Index of monthly manufacturing activity, South and West

Base: Average month 1923-1925 = 100

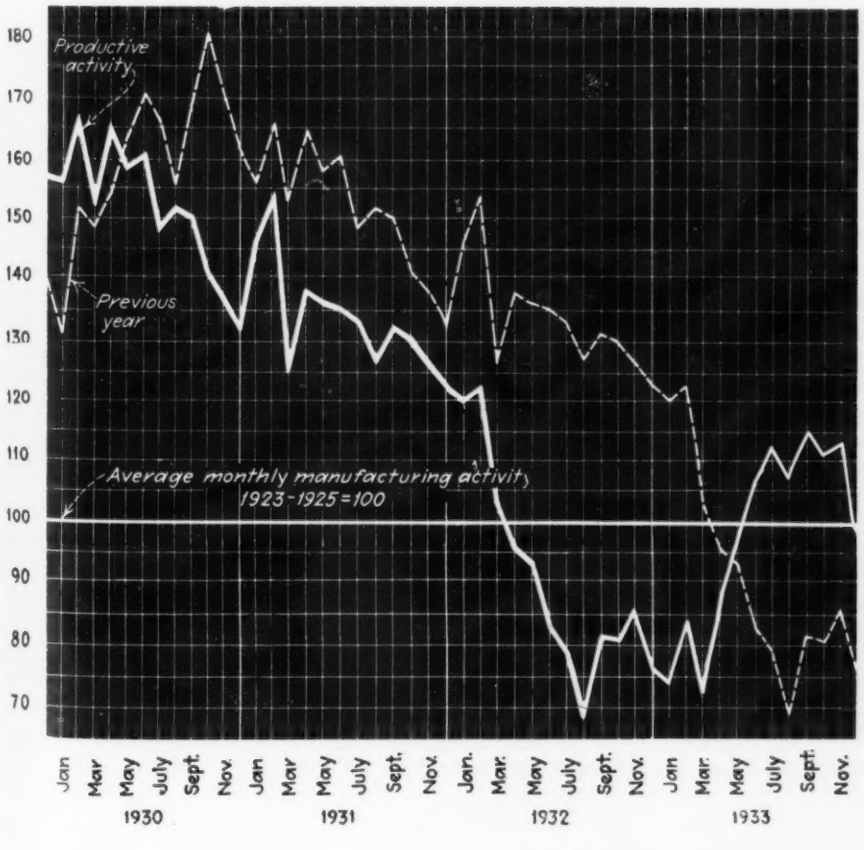
(Corrected for number of working days, but not for seasonal variation)

	South					West				
Industrial Groups	Dec., 1933	Nov., 1933	Oct., 1933	Sept., 1933	Dec., 1932	Dec., 1933	Nov., 1933	Oct., 1933	Sept., 1933	Dec., 1932
All Industry	**108.8**	**113.3***	**112.0**	**121.3**	**94.1**	**116.3**	**116.9***	**113.3**	**112.8**	**93.8**
Chemicals	182.0	166.1	163.3	181.0	142.6	90.3	86.0*	91.2	85.8	76.8
Food products	127.8	153.6*	161.5	174.8	124.3	118.5	118.9	111.3	119.3	113.2
Iron and steel	145.4	110.8	110.3	114.8	57.6	....	....	....	....	....
Metal working	90.3	82.5	90.0	99.1	54.5	....	....	....	....	....
Metals group	122.2	98.8	101.3	107.8	56.3	80.1	76.3*	75.3	76.2	37.5
Lumber	40.8	46.3	50.8	53.5	38.7	156.7	162.8*	155.3	153.1	130.3
Paper and pulp	180.1	181.2	176.6	186.7	138.4	125.7	135.0*	145.4	138.2	125.5
Rubber products	77.0	69.5	102.8	129.7	30.6	97.7	97.5	92.5	97.0	50.2
Shipbuilding	....	....	....	....	....	118.0	123.0	114.0	113.0	112.4
Stone, clay and glass	122.8	109.0*	60.4	101.8	117.3	122.3	120.0*	118.2	119.6	64.5
Textiles	108.8	123.1	120.0	124.0	108.8	....	....	....	....	....

*Revision.



Electrical Works Slacken Activity



After a rise during the earlier part of the year to an average index number of 111 for the five-month period from July to November, activity in electrical manufacturing plants during December fell to 99.4 on the 1923-1925 base, measured by reported energy consumption. The decline of 11 per cent left a liberal gain, however, compared with the average of 77.4 (misprinted in the issue of December 23) for the first quarter of 1933, and an increase of 31 per cent over December, 1932.

The decline seems to have been due mainly to slackened production of appliances after meeting holiday trade demands, while activity of large plants producing industrial equipment was well maintained.

Monthly Index of Electrical Manufacturing Activity

Adjusted to 26 working days

Base: Average Month, 1923-1925

	1930	1931	1932	1933
January	156.2	146.6	120.0	74.0
February	165.2	154.3	122.2	83.3
March	153.0	126.1	102.9	75.0
April	164.9	138.1	95.6	89.4
May	158.0	136.7	92.8	104.1
June	160.2	135.2	83.1	106.9
July	148.5	133.4	79.2	114.0
August	152.2	126.9	67.6	108.4
September	150.0	132.6	81.4	115.2
October	140.6	130.4	80.9	111.7
November	137.5	126.9	85.6	107.0
December	132.4	123.5	76.0	99.4

Factors Affecting Adoption of Electronic Control in Industry

By C. STANSBURY
Cutler-Hammer, Inc., Milwaukee, Wis.

Here is the viewpoint of an engineer who is neither a rabid enthusiast regarding the applicability of electronic control nor a believer that present forms of magnetic control are necessarily the final answer. He gives reasons why electronic control has not been more widely accepted industrially and points to the factors that may determine the appropriate fields of this and magnetic control. The most attractive applications are where small actuating power is available and high speed of response are necessary. The various phenomena and events to which control must be responsive are important elements in the choice of control. Economic limitations to the use of electronic control are cited indicating the direction that further development must proceed to overcome them.

WITHIN recent years very optimistic predictions have been made regarding the extent of future use of electronic apparatus in industrial control. While it is true that economic conditions have greatly affected the extent to which these predictions have been realized, it nevertheless appears to many engineers and others who have become converted to the possibilities in this direction that the extension of electronics in this field is not taking place as rapidly as might have been expected.

There have been notable applications in the field of resistance welding and various applications of light-sensitive devices, such as limit switch applications using light-beam relays, but the fact remains that the great bulk of industrial control is without electronic elements, and promises to be so for some time to come. The writer believes that there are three primary reasons for this situation:

1. The predictions referred to were overoptimistic and not based on a realistic appreciation of the factors which would control the general use of electronic devices.

2. The high prices at which new industrial tubes have been introduced, taken together with the relatively short life so far obtainable in many cases, has frequently resulted in dissatisfaction with installations and in a tendency to substitute more permanent apparatus wherever possible.

3. A great deal of educational work has been necessary, not only among the prospective ultimate users of such apparatus, but also within the organizations of the various manufacturers.

A number of plant executives and engineers have taken considerable trouble to inform themselves along this line, but generally speaking it is true that the average prospective user has no clear idea as to just where electronic apparatus may fit into his problems. It is found that if he has an opinion along these lines it is probably a vague one, which may vary all the way from an impression that magnetic contactors and relays and the like are all obsolete and headed for the scrap heap to make way for electronic apparatus, to the reverse opinion that electronic apparatus is of the nature of a scientific toy, too delicate and unreliable to be depended on in industrial processes.

In the hope of clarifying this situation somewhat the writer presents what he believes to be the logical place of electronic apparatus in industrial control. It is based on several years of experience in development and exploitation of this type of apparatus. Roughly, electronic control apparatus may be divided into three classes:

1. Apparatus having a relay function, analogous to magnetic relays.

2. Apparatus for controlling power currents directly analogous to magnetic contactors, but including additional regulating features.

3. An intermediate class, including such things as motor field regulators in which tube apparatus has a function analogous to common rheostats or to vibrating-contact regulators.

There is, of course, no sharp line of demarcation between these classes, but they form a convenient basis of discussion.

Magnetic vs. Electronic Relays—For the average general-purpose control the conventional magnetic relay has little competition from the electronic relay, provided actuating power on the order of one watt or more is available and the permissible operating time is not less than about 1/20th second. The magnetic relay is simple, cheap, rugged, permanent, passes current in both directions, requires no auxiliary apparatus, may be multipole and has its actuating circuit insulated from the circuits it controls. However, where the actuating power available is a small fraction of one watt, or the operating time considerably less than 1/20th second, or both, the use of electronic relays is indicated. It is true that magnetic relays are available that operate on much less than one watt, or in operating time much less than 1/20th second, but these figures represent at least approximately the upper limit of the logical field of application of electronic relays. These relative fields of application are represented graphically in Fig. 1, which also brings

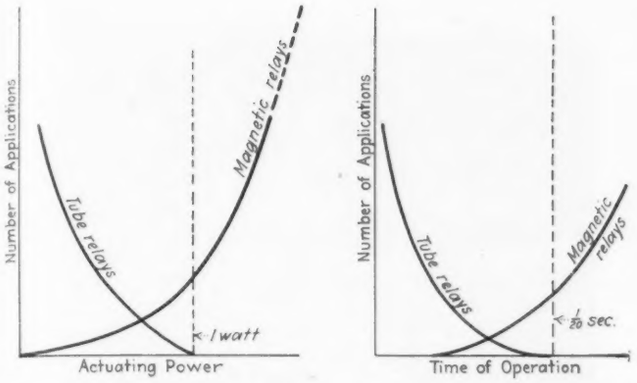


Fig. 1—Relative applicability of tube vs. magnetic relays

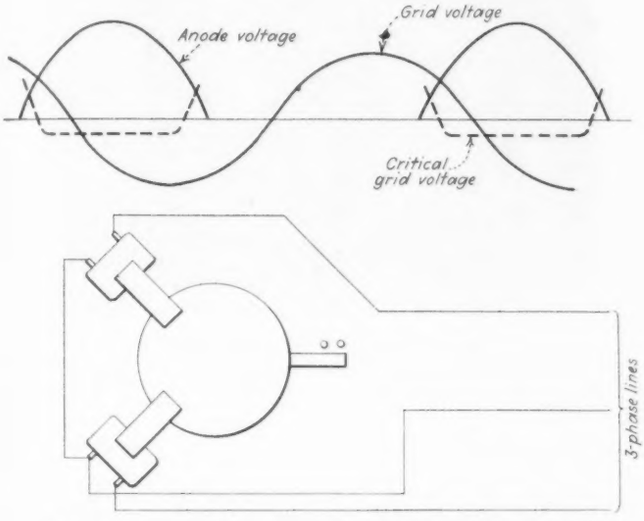


Fig. 2—Comparison of electronic with magnetic phase-failure relay

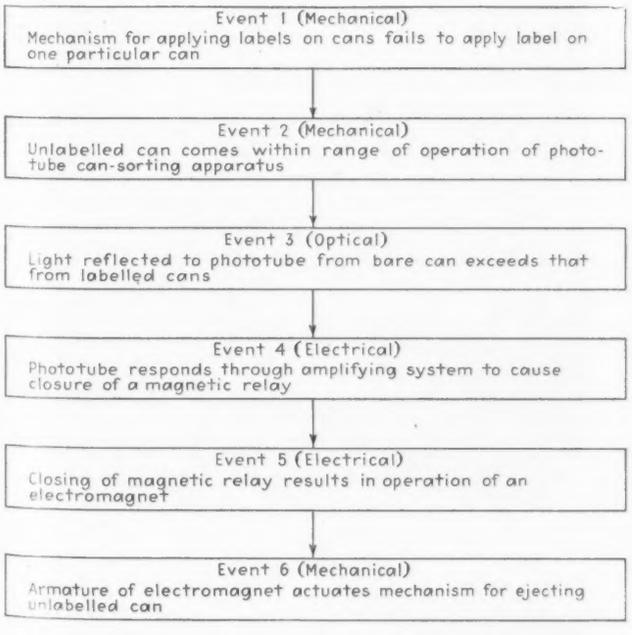

Event 1 (Mechanical)
Mechanism for applying labels on cans fails to apply label on one particular can
Event 2 (Mechanical)
Unlabelled can comes within range of operation of photo-tube can-sorting apparatus
Event 3 (Optical)
Light reflected to phototube from bare can exceeds that from labelled cans
Event 4 (Electrical)
Phototube responds through amplifying system to cause closure of a magnetic relay
Event 5 (Electrical)
Closing of magnetic relay results in operation of an electromagnet
Event 6 (Mechanical)
Armature of electromagnet actuates mechanism for ejecting unlabelled can

Fig. 3—Sequence of events in a can-sorting machine

out the fact that there is an overlapping zone, with respect to both the actuating power and the time of operation, within which either general type may be applicable.

For example, most light-sensitive devices (photoelectric cells and the like) will only pass minute currents. In amplifying these currents for industrial purposes with tubes, there is in many cases no particular hurry about the response (as witnessed by the fact that the response is made effective through relatively slow-acting magnetic devices), but the power available for causing the response may be only a few millionths of a watt. On the other hand, in a sensitive speed regulator for a motor there may be available for regulating purposes enough power for operating any reasonably efficient type of regulator, but the speed of response required may make an electronic regulator more suitable. Or, finally, both the required response time and the actuating power available may be extremely small, as in the case of phototube control of the register of rapidly moving printed paper with the cutting and folding mechanism in a bag-making machine.

An important result of their relative response speeds is that in a.c. applications magnetic relays practically always respond to some sort of average effect of the impressed voltage or current cycles, while electronic relays may respond to occurrences within individual cycles. This results from the mechanical and electrical inertia of the former and its absence in the latter. This is brought out by a comparison of the electronic and magnetic phase-failure relays in Fig. 2. In the former, the circuits (not shown) are so devised that under proper phase conditions the relation of grid to anode potential is as shown, so that the gaseous tube conducts during each positive half-cycle. In case of departure by the polyphase supply from proper phase conditions, the grid-voltage wave is caused to shift in phase relative to the anode-voltage wave in such a way that conduction through the gaseous tube is prevented. The conditions obtaining during each individual cycle determine whether the gaseous tube shall conduct within that cycle. On the other hand, referring to the phase failure relay of the well-known wattmeter-disk type, the mechanical inertia of the relay is such that the opening or closing of the contact is determined by an averaging effect involving the phase conditions throughout several successive cycles.

Power Apparatus—As far as the commonly accepted province of "industrial control" is concerned, electronic apparatus for passing power currents primarily has to do with interposing tubes between the supply lines and industrial motors. "When are we going to stop using contactors, grid resistors and that kind of thing and start running motors through tubes?"

The answer, of course, is that it has been proved to be practicable from a physical standpoint to operate motors in this way, but applications in the industrial field in which such operation is economically justifiable seem to be rare. Motor applications justifying power control by tubes seem to be limited either to very small motors, in which case, the tube apparatus is relatively small and cheap and voltage drop through tubes involves negligible power loss, or to very large motors using high voltage, where special requirements of speed flexibility or other factors justify the complication and the voltage drop through the tubes is small compared to line voltage.

Neither of these cases has wide application in the industrial field.

The important fairly recent developments in this line all seem to relate to the so-called "commutatorless motor," in which the variation in the distribution of currents in motor windings with time is effected by grid-controlled tubes. This seems to involve a type of motor which is distinct from those now commonly used. The electronic apparatus involved is really a part of the motor and not a distinct and fairly flexible element like the ordinary industrial controller. Applications in the transportation field and possibly for large power main drives will possibly be extensive, but it is difficult to see any justification for extensive industrial use.

At the risk of present or future ridicule, the writer predicts that power current applications of tubes in industrial control will continue to be rare. A notable exception is in resistance welding. There will doubtless be others.

Regulating Apparatus — This intermediate class includes such electronic apparatus as motor and generator field regulators, controllers for the d.c. current of saturable reactors, and the like. The non-tube equivalent of such regulators is either a rheostat or a vibrating-contact regulator. The justification for the use of tubes in this class in place of other types of apparatus rests on the same fundamentals as in electronic relay applications, namely, high speed and/or small actuating power.

Take the case of an ordinary simple field rheostat controlling the speed of a shunt motor. Such a rheostat can be replaced by a little pilot rheostat or reactor controlling the amount of average current allowed to pass through a pair of gaseous tubes. Such a substitution is, however, not justifiable economically at the present time in other than exceptional cases where it may be necessary to regulate the field in response to very small mechanical forces or something of that sort. As this type of tube becomes cheaper it may become justifiable to use the tube combination in place of the ordinary rheostat in a number of installations for which it cannot be considered at the present time.

A great many drives for machine tools, particularly on lathes, use a d.c. motor with its field regulated by a mechanically operated rheostat which is linked up to a lever at the operating position by means of a spline shaft, gearing, sprockets, chains, etc. In this case a great deal of mechanical apparatus could be eliminated with resulting simplification of machine design by controlling the motor field through a pair of gaseous tubes, which would in turn be controlled by a little pilot rheostat or reactor mounted at the operating position. It is doubtful if such a substitution is justifiable at present because of the high initial and replacement cost of the tubes, but this will not necessarily be the case in the future.

This seems to the writer to be the most promising field for tubes in industrial control as far as field regulation is concerned. There already are, and there will be more, special cases such as those requiring co-ordination of motor speeds with the feeding of materials, but such jobs are entirely special and not particularly numerous.

Actuating Means in Automatic Control Systems—One prominent engineer in the electronic field has expressed the opinion that the principal industrial function of electronic apparatus can be reduced to a question of "extension of the senses." In other words, such apparatus makes it possible to build control apparatus which

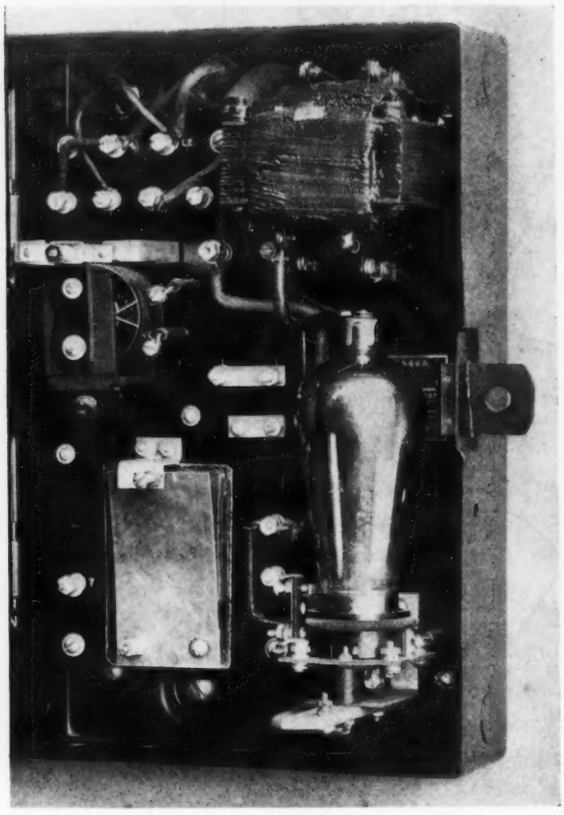


Fig. 4—Typical light-beam relay

Devices responsive to light constitute perhaps the most important of electronic developments in industrial control.

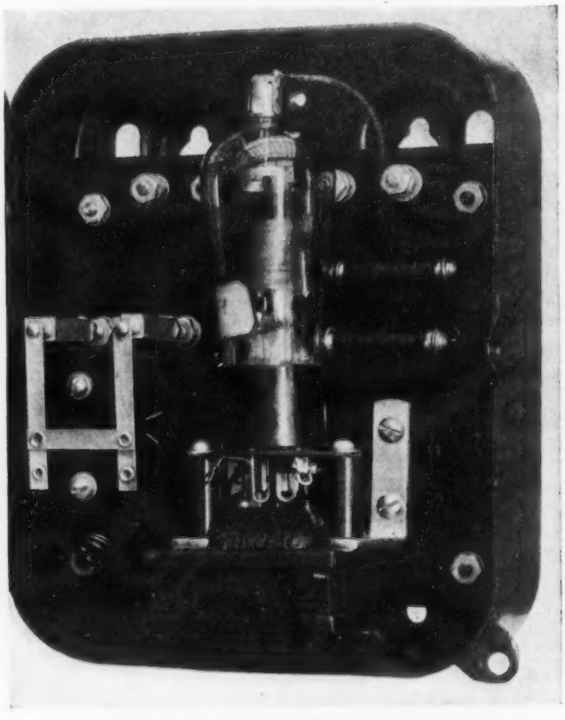


Fig. 5—Excellent but expensive

The electronic phase-failure relay for elevator application gives superior protection, but will not be widely acceptable commercially until low-cost gaseous tubes are available.

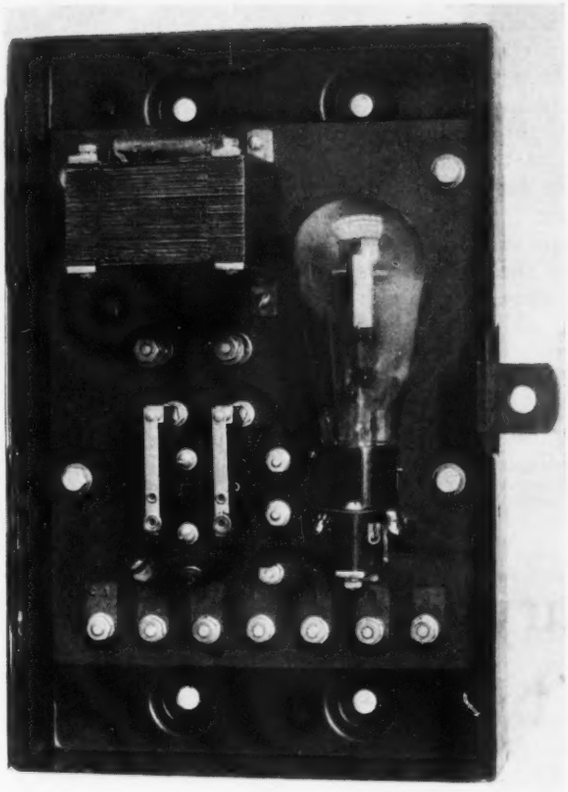


Fig. 6—Copper-oxide rectifier stands in the way

Small full-wave tube rectifiers of this type for magnetic chucks and the like are at a disadvantage in competition with copper-oxide rectifiers because of the expense of periodic tube replacements.

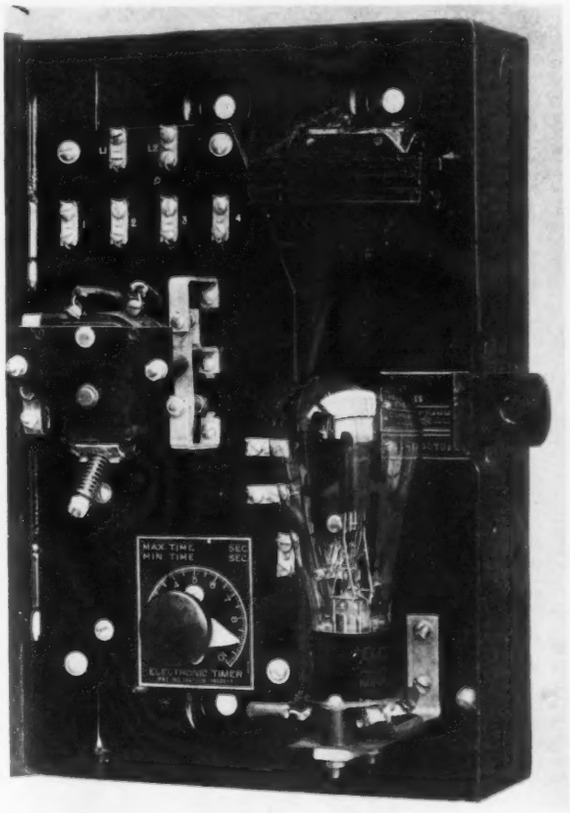


Fig. 7—Accurate short period timing

An important form of electronic industrial control is the condenser-resistor timer as exemplified by this resistance welding controller.

will perform under a given set of circumstances just as a trained operator would perform under the same conditions, except infinitely faster and in response to much smaller stimuli. The place of electronic apparatus is thus in connection with automatic functions and warrants a discussion of the general nature of automatic machinery and the relation of electronic apparatus to it.

From the standpoint of the control engineer, any automatic machine carries out a sequence of events artificially set up by the designer, and in which his particular type of apparatus may play a major or a minor part depending on how well it fits into the rest of the sequence. A typical sequence of events is shown in Fig. 3. It will be seen that the field of industrial electronic-tube control, in this case, is limited to event 4. It responds to optical event 3 and results in electrical event 5.

The immediate result of the functioning of industrial control apparatus is, more or less by definition, limited to a change in the continuity or the impedance of a controlled electrical circuit, such as completion of the coil circuit of the electromagnet in the above example. Extension of the usefulness of control apparatus will, therefore depend primarily on the extent to which the number of events or phenomena to which it can be made to respond is increased. The commercial application of photocells, making control apparatus responsive to light, is an important case in point.

The machine designer is continually setting up event sequences like the one shown. In early machines most of the individual events were mechanical, but for many years electrical events have also been included. Electronic apparatus extends the types of such events to those connected with light, sound, the presence of minute mechanical forces, and so on.

Thus the first thing the designer of machinery needs to have available, in the consideration of electronic elements in his machine, is as complete a knowledge as possible as to what are the various phenomena and events to which such apparatus can be made responsive. The principal ones in use at present are as follows:

1. Response to magnitude of voltage or current (with negligible energy drain, instantaneous).
2. Response to phase relation of polyphase voltage or current.
3. Response to frequency of alternating current.
4. Response to light.
5. Response to sound.
6. Response of small conducting bodies in a magnetic field.
7. Response to variations of electrostatic field (caused by mechanical variations of separation of condenser plates or by changes in the nature of material passed between the condenser plates).
8. Response to variations of mutual or self-inductance of windings associated with a magnetic field (caused by saturation of the iron core with a d.c. controlling winding, or by relative movement of parts of the magnetic circuit).
9. Response to variations of ohmic resistance caused by application of pressure to material, variations of temperature, moisture content, humidity, etc.

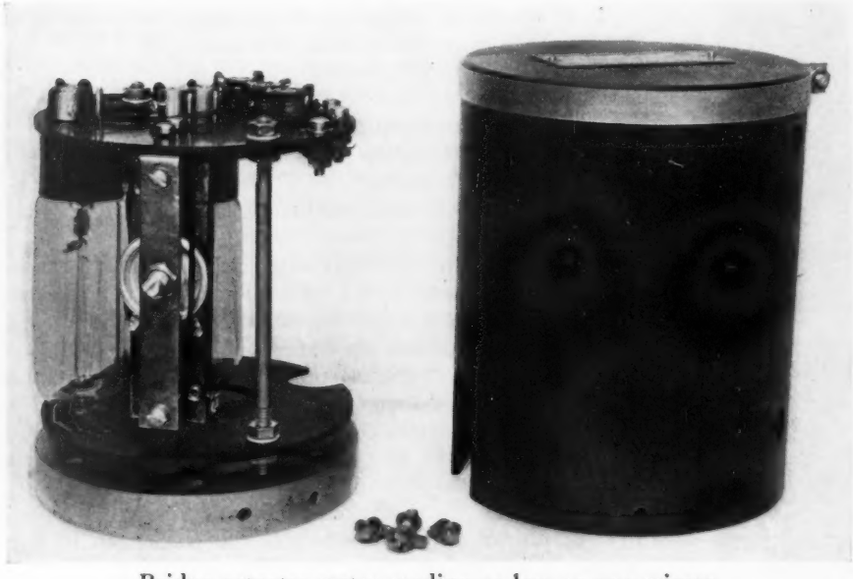
The practical situation at the present time may be expressed by the statement that electronic apparatus is not being used in industrial control apparatus in any case where some other type of apparatus can be found to do the job at a comparable first cost. Industrial tubes have so far been expensive and their life has not been particularly long. Regardless of what may be said by its advocates, such apparatus undeniably requires more intelligence and careful handling than the usual control apparatus. Buyers of industrial control apparatus have become accustomed to installing a controller and to being able to dismiss it from mind with the exception of occasional inexpensive replacement of contacts and the like. Introduction of apparatus requiring fairly frequent and expensive replacements of elements is naturally meeting opposition. To a considerable extent more extensive application of electronic control is awaiting lower tube prices, which may not be practicable until sales volume increases. This doubtless is a temporary condition.

The writer likes to compare the present situation with regard to tube apparatus with that exsiting in the pneumatic automobile tire industry twenty or more years ago. At that time a single automobile tire cost more than a whole set does today and was a rather unsatisfactory device. There was general dissatisfaction, attempts to design substitutes were numerous, and in some cases fairly successful. Electronic apparatus is just about in this stage today with regard to the industrial control field. The writer confidently expects that it will pass through the rest of the cycle in years to come, that we shall have far better tubes in the future at a fraction of the present cost, together with that accumulated skill in their use on the part of manufacturers and users which is indispensable.

Half Micron of Mercury Indicated by Electric Gage

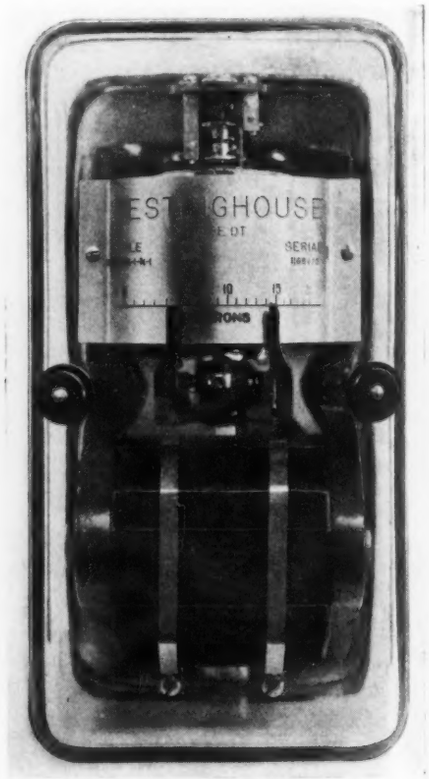
By PAUL MacGAHAN
Meter Development Engineer,
Westinghouse Electric & Manufacturing Company, Newark, N. J.

CONVECTION of heat away from a platinum filament by so little residual gas or vapor as is represented by only one micron (0.6 of a millionth of an atmosphere) is sufficient to enable a platinum resistance thermometer to indicate vacua values directly on a new switchboard instrument. This sensitivity makes it a logical auxiliary of mercury-arc power rectifiers. When pressure rises from the normal one micron value toward 10 microns the risk of arc-back or back-fire increases.



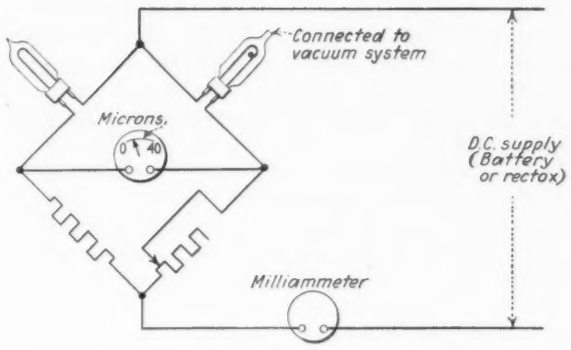
Bridge actuates meter reading as low as one micron

Residual gases cool the filament of Pirani detecting bulb (at left) by convection, influences its resistance and indicates degree of evacuation in space to which it is piped. Gr ;e unit contains detecting bulb, sealed-off compensating bulb, two bridge-arm resistances and a series adjusting resistance (see accompanying diagram). Vacuum-tight gaskets and micarta protecting cover complete the assembly.



Bridge also actuates control relay

This supersensitive relay, with contacts adjustable from 0 to 10 microns, prevents operation of mercury rectifier when vacuum is not within safe limits.



Micron meter is unbalance-galvanometer of Pirani-gage bridge

The wheatstone bridge network is energized by d.c. obtained from the available a.c. power supply through a "Rectox." The bridge is balanced at a resistance in the filament arms corresponding to zero pressure or most important point of the micron instrument scale so that ordinary variations of supply voltage have but little effect upon the readings of the indicator. The indicator is a switchboard milliammeter, calibrated in microns, connected to the output terminals of the bridge.

Indication, alarm and automatic control of the rectifier are obtainable from the new instrument to insure most effective and reliable functioning of the rectifier.

The well-known McLeod pressure gage is important as a standard of volume of gas content, but requires manipulation to obtain readings. However, for operating purposes, the electrical "Pirani" type gage is preferable. Based upon the Pirani principle, a switchboard indicating type of vacuum gage has been produced, utilizing an extremely modern sensitive d.c. permanent magnet moving coil switchboard instrument calibrated to read in microns direct. It will indicate the presence of gas molecules in the "vacuum" when they are less than one-millionth of the number in the same volume of air, at atmospheric pressure.

Essentially a bridge milliameter

The gage consists of a wheatstone bridge network comprising two permanent resistances and two fine wire platinum resistances or "filaments" mounted in glass containers, with terminals such as used in ordinary radio tubes. One of these bulbs is evacuated to a pressure of approximately 2 microns, sealed off, and thoroughly aged to make sure it remains stable. Repeated pumpings with intermediate aging periods are required to reach a stable condition. The other bulb is arranged with a projecting tube and compression flange, for connection to the vacuum system of the rectifier. Pure platinum strip is used in the filament on account of its high temperature coefficient of resistance and its stability under the influence of mercury or water vapors.

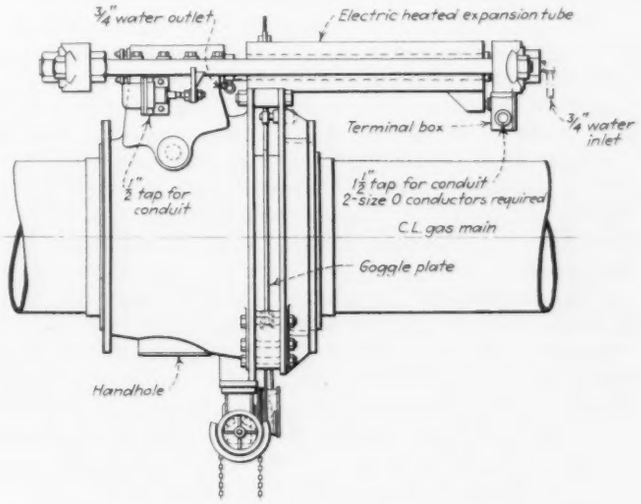
The bridge arm resistances are a combination of manganin wire and copper wire, arranged to compensate for variations in external temperature which would otherwise affect the accuracy of the unit. The series resistance is as required to supply the network with a value of current in the detecting bulb filament giving the maximum sensitivity to variations in gas content for the range in pressure for which the outfit is intended. At low filament currents and, hence, temperatures, the energy dissipated is too low to give sufficient output from the bridge to the indicating instrument. At high filament currents the energy is dissipated not only by gas convection but also by radiation, making the bulb somewhat indifferent to the amount of gaseous matter contained. The point of maximum efficiency is obviously the same as that at which the bulb is least affected by variations in current and thus most nearly independent of applied voltages.

The network used on the sectional type mercury-arc power rectifiers operates at a normal current of 90 milliamperes, supplied by a "Rectox." The switchboard indicating instrument has a coil resistance of 6 ohms and a sensitivity of 0.002 amp. full scale with an operating torque approximately the same as in the usual d.c. ammeters or voltmeters of the same kind.

The readings of the hot-wire electrical Pirani gage will not agree under all conditions of vacuum with readings shown by a McLeod gage. The McLeod gage depends upon the amount of gas volume contained in the vacuum, whereas the electrical gage depends upon the cooling effect of gas molecules in contact with the filaments. Further, in the McLeod gage the mercury, and usually the water, condenses in the tube so that the amount is not measured. Molecules of different gases, air-water vapor or mercury vapor carry off different amounts of heat from the filament, and thus the readings will depend upon the nature of the contents of the vacuum.

Goggle Valves Released by Electric Heat

Goggle valves, using the thermal principle to separate the flanges, extensively used to control flows in large gas mains, have until recently had their expansion tubes generally heated by steam. Electric heating of these tubes has now removed the limitations which prevented the use of these valves where steam was objectionable or not available. This new use for electric heat is due to a joint development of the Ajax Electric Company, Philadelphia, and the William M. Bailey Company, Pittsburgh. It also offers advantages over



Electric heat to expand valve flanges

Tube expansion separates flange so diaphragm or goggle can be opened or closed, gas and steam tight.

steam in the larger mains, some of which are 10 ft. in diameter.

A goggle valve consists of a thin rolled plate or diaphragm in the form of a disk which can be swung between flanges that terminate rigidly held sections of the mains either side of the valve plane. Under normal operating temperatures the flanges make a gas- or steam-tight joint against the faces of the "goggle-shaped" diaphragm. Prevailing thermal expansion designs had employed steam to heat the expansion tubes to about 300 deg. F., their consequent expansion relieving the flange pressure so that the valve disk could be moved to a full open or closed position. Electric heater units make possible tube temperatures of 900 deg. F. with corresponding decrease in necessary length and cumbersomeness of the valve installation, especially a factor in the smaller mains.

Power consumption is of course small because it is incurred only when the valve is operated. Energy demands for the quick heat required run from 15 to 50 kw., depending on the size of the main and whether one or three tubes is employed in the design.

LETTERS TO THE EDITOR

Present Status of the Inquiry on Distribution Costs

To the Editor of the ELECTRICAL WORLD:

It is a healthy omen that interest in distribution costs of electric energy, aroused by discussion of the subject at the Institute of Public Engineering held in New York City on January 20 of last year, continues to grow. My paper read at this meeting was a condensation of a report I had made to the Power Authority of the State of New York, based upon an examination of the data contained in the annual reports of the power companies of that state to the Public Service Commission. Both report and paper were titled "Distribution Costs of Electric Energy with Special Reference to the Residence and Rural Customer." The ELECTRICAL WORLD of March 18, 1933, carried a very extensive summary of the paper.

Doubtless owing to its being the first attempt broadly to consider this subject, my paper aroused considerable interest. Very naturally I should have preferred to present such a paper to my own national society, the American Institute of Electrical Engineers, but thus far its directors have declined papers discussing costs or other money factors. Next, I should have preferred the American Society of Mechanical Engineers, but this society does not feel that electrical distribution lies within its field.

The reactions to the paper at the conference were of interest. Some engineers of municipal plants considered my cost figures too high. Others, chiefly utility engineers, held them too low. But much to my gratification, all present seemed to hail my effort as an honest piece of pioneer work in a neglected field. In a fine spirit of professional understanding, they accepted my warning that I regarded my results not final but tentative, subject to the refinements which criticism and added information would surely bring. The temper of the meeting seemed to be that, as engineers on the trail of truth, we had made a start and the search should go forward.

Doubtless engineers and inquirers have been testing out the figures proposed with data from their own localities with whose work I am not yet acquainted. There have been, encouragingly enough, many inquiries from state utilities commissioners and other public officials, as well as from editors and civilians. There has been some discussion in the trade press.

I heartily welcome such interest, but as we go forward with this inquiry in an effort to arrive at reasonably accurate standards and as new men join in the enterprise a restatement of our objectives becomes desirable and is here made to avoid confusion and lost motion.

The search is for a ready method of determining "distribution" costs as distinct from the costs of generation, transmission or inclusive "system costs."

> Distribution as defined for the purposes of the Institute of Public Engineering includes all expenses—capital and operating—direct and indirect—from the low-tension side of the distribution substation to and including the customer's meter. The term, therefore, is much more inclusive than as used in the Uniform Classification of Accounts.—What Electricity Costs, page XIV.

The line is thus very sharply drawn. To assert such costs cannot be ascertained for practical purposes is to impute impotence to the engineering professions. To attempt to import unwarranted system costs over this line is to inject confusion and defeat the purposes of the inquiry—if, indeed, this is not the intent. There are enough uncertainties on our side of the line, as I have pointed out, without injecting extraneous matters.

Moreover, it is not contributing to sound research to spread abroad misstatements of fact or misleading accounts of our purpose and theory. The unfortunate results of such misrepresentations are exemplified by an article in the New York *Times* of December 10. Here the author, Dr. Norman R. Gibson, vice-president of the Niagara Hudson Power Corporation, himself an engineer, states categorically that the results of Pike's inquiry have been "invalidated" because "he fell into certain fundamental errors in allocation (*already pointed out in the technical press*)" (italics mine). Dr. Gibson undoubtedly refers to two articles which have recently appeared. One by Col. Hudson W. Reed, management engineer for the United Gas Improvement Company of Philadelphia, in the *Public Utilities Fortnightly* for November 2 and 9—"Common Fallacies about the Average Cost of Distributing Power"; the other by Constantine Bary, engineer, rate and standard practices department of the Philadelphia Electric Company, on "Distribution Costs of Electric Service" in the ELECTRICAL WORLD of August 19.

Colonel Reed seeks to demonstrate that the much-discussed "spread" between domestic and power rates is justified. Mr. Bary attempts to prove that distribution costs are much higher than I had figured them. Both ridicule the idea that average costs are of any real value. Mr. Bary opens his article with a solemn preachment on the great danger of using average costs. The reader

is led to assume that Pike relies upon average distribution costs as a geometrician relies upon Euclid's laws and thus throws a cloud of doubt over Pike's whole paper.

He thus suggests an unprofessional dogmatism which neither myself nor others concerned with this inquiry possess and have taken care to disclaim. He announces the danger of average costs as though it were a discovery unknown to me. He is quite mistaken and his disquisition gratuitous, for at the New York Institute I specifically pointed out the danger of *careless* use of averages, as did Samuel Ferguson and Colonel Reed. The whole of page 11 of my report to the New York Power Authority is given to "Items Affecting Distribution, Investment and Costs." Morris L. Cooke in his introduction to the book "What Electricity Costs," consisting of the papers read at the institute, which book, by the way, is noted by Mr. Bary, again remarks upon the careless use of averages, but at the same time affirms the legitimate use of averages employed as a matter of course in the engineering professions.

One would think such precautions would have been observed and respected by so meticulous a critic as Mr. Bary, but it seems not.

Mr. Bary's method is again illustrated by his attack upon an equation I considered of no real consequence to the paper, but tentatively introduced to represent the approximate investment in distribution facilities for an average customer. It was, admittedly, the best I could deduce from data at hand and I trust future investigators will produce a better one, which they undoubtedly can.

With great ado, however, the gentleman centers attention upon this equation and its trial figure of $65 and in his own peculiar way, which consisted of making two assumptions palpably absurd, demonstrates to his own satisfaction that it must be erroneous. Passing over his dialectics to his use of facts, let us examine the correctness of his "corrected" figures which he sets up in a table against my own. He not only charges me with grave "omissions" but, surprisingly enough, states that his figures "are derived from the same basic data as used by Mr. Pike." Manifestly, he and I were taught arithmetic in different schools since we report such strikingly different figures from the same sources.

As to omissions, Mr. Bary claims my estimates gave no consideration to "construction overheads" or to "working capital." As a matter of fact, both were carefully considered. The tables in Appendices IV, VI and VIII, which served as upper limits to my estimates concerning investment in meters, services, transformers, poles and wires, are based on reports of companies which had all but a little more than 2 per cent of the overheads absorbed into the figures given.

Working capital amounts to about the same percentage. Accrued depreciation, which should be deducted from my figures as the above should be added, amounts for those New York companies having distribution systems only to over 10 per cent. Therefore I omitted by name from my institute paper for simplicity the overheads and working capital, since their effect was overbalanced by the item of "accumulated depreciation."

A brief examination of some of the "corrected figures" of our critic will be illuminating:

Poles and Wires—He "corrects" my figure of $30 to $61.50: First by raising the number of feet of conductors per customer by 10 per cent. Second, by raising my figure of 6 cents per foot up to 10 (the excuse being that the average for all customers, residence, commercial and power, in my Table III gave about this amount. The figures derived from the tables were merely an upper limit in judging a fair cost. Lower limits were obtained from my general knowledge and special experience as a former contractor). Third, he adds 12 per cent for construction overheads, most of which were already included in the upper limit. No wonder that the figure of $61.50 was reached.

Line Transformers—My figure of $6.50 per residence customer is elevated to $8.56. Col. Hudson Reed in his *Fortnightly* article, previously referred to, uses $6.30 or less than my figure.

Meter and Service: This item is boosted from $15 to $24.75. The gentleman's respectful attention is called to the figure of $15.05 used by Marshall and Snow in their paper read before the 54th annual convention of the National Electric Light Association in June, 1931. Many other confirmations of the figure of $15 could be cited.

Distribution Expense is raised from $2 to $2.96. My figure was based on 3.5 per cent of the distribution investment. Marshall and Snow used 2.5 per cent. Col. William Kelly uses per residence customer $1.96. Springfield, Ill., actual for 1932 was $1.73 and London, Ont., $1.48.

Utilization Expense is marked up from 50 cents to 70 cents. In five municipalities the actual expense is from 52 cents down to 22 cents.

General Expense is expanded from $1.05 to $1.61 through the process of inflated investment. Apropos of this, Los Angeles expense, where labor is relatively high, is only $1.17. London, Ont., with a usage of 3.5 times as great, $1.02, and Springfield, Ill., with consumption over twice as large, $1.24.

Taxes—Even my tax figure of 1.4 per cent on investment does not satisfy our critic. He discovers another omission and adds a theoretical 0.62 per cent for federal income taxes, bringing his total to 2.02 per cent.

But the income tax has no place here. It is very uncertain. Many companies pay none. It is a tax on profits, not on costs. We are seeking here the "costs" of distribution, not the "charges" for it. The fact that courts give it consideration in rate cases is not germane to this study, which is not intended for rate cases. However, if Mr. Bary will look up the taxes paid by his own company for the year in which my investigation was made (1930) he will find that my allowance of 11.5 per cent for taxes and insurance is liberal enough to include the federal income tax.

These instances illustrate the process by which my figure of $55 for investment in distribution facilities per average customer was raised to $103.90 in a heroic attempt to prove my work unsound. Apparently the inflation fever from which some utility financiers were suffering around the 1928 period was contracted by some of their engineers and still persists.

I may add that in recent months I have had opportunity to study average distribution costs in a large number of individual communities and feel even more confident that the assumptions of my paper will be found to be essentially correct, including both the figure of 2.36 cents per kilowatt-hour as average distribution cost for an average residence customer and the method by which it was determined.

Not only am I still hoping that future analysis of this very important matter will be constructive but also that several engineering societies will foster it by opening their meetings to full presentation and discussion.

Otherwise, progressive state commissioners, municipal and independent engineers and an interested public may be forced to perpetuate the Institute of Public Engineering, or create some other agency of enlightenment.

CLAYTON W. PIKE,
Consulting Engineer.
Philadelphia, Pa.

THIS WEEK'S NEWS

Recent Progress in Many Lines Told at A.I.E.E. Meeting

MARKED by reports of notable technical progress, honors paid to two pioneers in the art and unusually interesting demonstrations of progress in communications, the annual winter convention of the American Institute of Electrical Engineers came and went this week. This year marks the fiftieth anniversary of the institute. The February 3 issue of ELECTRICAL WORLD will contain a comprehensive report of outstanding papers and of significant discussions.

In general, the courage of the electrical engineer in proceeding through depression years toward progress in the technical advance of the art was again manifest. In power applications, transportation, communication, protective devices, generating apparatus and control equipment the now familiar story of unrelenting effort toward improvement was told.

Edison medal awarded Kennelly

Dr. Arthur E. Kennelly, electrical pioneer, professor of electrical engineering at Harvard University and a past-president of the A.I.E.E., was awarded the Edison medal, highest of institute honors. The recipient, who had been the principal electrical assistant of Thomas A. Edison, from 1887 to 1894 in the Edison Laboratory at Orange, N. J., pointed out that the electric age in which we now live has been largely built up on the discoveries and inventions of Edison, who was a great pioneer in electric power distribution, in illuminating engineering, and in acoustical engineering.

A very early form of tinfoil phonograph was displayed and operated. It was a preliminary type of the phonograph that Mr. Edison discovered and exhibited more than 50 years ago.

Frank J. Sprague, likewise a past-president and recipient of the Edison medal in 1910, was present when a bronze bust commemorating his activities as "the father of modern rapid transit" was presented to the institute. Dr. John B. Whitehead, president of the A.I.E.E., received this gift from Frank Hedley of the Interborough Rapid Transit Company.

Startling demonstrations of the recently developed auditory-perspective type of sound broadcasting were made at the Edison medal presentation meeting. Dr. Harvey Fletcher of the Bell Telephone Laboratories displayed the full control of sound reproduction with three-dimensional broadcasting. The development, announced several months ago, involves new designs of amplifiers, microphones and loudspeakers. The apparent source of sound may be controlled within auditorium limits.

Research cuts protested

Vigorous protest on behalf of the 16,000 members of the institute against federal slashes in funds heretofore available for fundamental scientific activities was voiced in a resolution passed by the A.I.E.E. board of directors. The resolution asked that "provision be made for the necessary and adequate technical standardization and research activities of the Bureau of Standards in the electrical field so that it may continue its valuable contributions to the art and industry." It was suggested that the American Engineering Council survey "this critical situation with the view of taking similar action."

Attendance this year was considerably above that in 1933. Up to Thursday morning 1,125 registrations were recorded, against totals for the whole convention of 1,099 last year and 1,429 in 1932.

Bankruptcy Orders Upheld; Insull Release Argued

Two orders of the U. S. District Court in the bankruptcy of the National Public Service Corporation, one refusing to remove the Irving Trust Company as trustee and the other giving permission to the trustees to enter into a compromise of claims in the case, were affirmed last week by the Federal Court of Appeals.

The court maintained that although there were strong reasons for independent trustees for each the question was not raised by the creditor until after eight months of negotiations for a reorganization. The creditor's action was filed following failure of the reorganization plan and after the trustee had asked permission of the court to compromise claims of the New York Trust Company and the Chemical Bank & Trust Company and all intercorporate claims growing out of them.

Martin Insull still fighting

Hearing on Martin J. Insull's appeal against a judgment refusing to release him from custody (ELECTRICAL WORLD, January 20, page 129) was adjourned early last week after a long session in the Ontario Appellate Court. I. F. Hellmuth, attorney for Mr. Insull, argued that authorities in Illinois had declined to allow the cross-examination of witnesses who gave depositions in Chicago and that had they given testimony more fully a different light would have been thrown on Insull transactions. Another attorney for Mr. Insull contended that Illinois neglected to enter evidence and exhibits which explained many of his client's transactions. Under those circumstances, he said, he felt obliged to urge his client to resist extradition.

North Carolina Board Rules on Appliance Profits

An order requiring electric and gas companies of North Carolina to segregate appliance merchandising in their annual reports has been issued by Utilities Commissioner Stanley Winborne. Heretofore profit or loss from sale of appliances was included in the regular operations account.

Independent dealers in electrical and gas appliances have complained that they are unable to compete with the utilities in this field, and charges have been made that the utiliites sold appliances at a loss. The annual reports for 1933, which are due in February, will present independent data on this for the first time.

P.G.& E. Offer Too Low, District Calls for Vote

Negotiations between the Pacific Gas & Electric Company and the Sacramento Municipal Utility District over the sale of power from the Silver Creek water supply system to be constructed with $11,700,000 in funds allotted by the P.W.A. have been terminated. Directors of the municipal utility district, by resolution, have turned down the agreement offered by the company. The contract submitted by Pacific Gas & Electric offered a price of 3 mills per kilowatt-hour. The directors asked 3.25 mills.

Appliance Board Prepares for Action; Knoxville Offer

Articles of incorporation, giving the Electric Home and Farm Authority power to buy, manufacture and sell electrical appliances in the United States and foreign countries were announced last week by David E. Lilienthal, president of the authority. The home and farm authority was created by President Roosevelt several weeks ago as a subsidiary of the Tennessee Valley Authority (ELECTRICAL WORLD, December 23, page 803). The board of directors of this new organization has authorized issuance of 10,000 shares of capital stock, with a par value of $100 per share, and also authorized execution of a contract with the Reconstruction Finance Corporation looking to the setting up of $10,000,000 of credit in connection with the Tennessee Valley electrification program. In addition to David E. Lilienthal, president, officers of the Electric Home and Farm Authority, Inc., include Arthur E. Morgan, chairman of the T.V.A., vice-president; Francis J. Carr, controller of the T.V.A., treasurer; Dr. Harcourt A. Morgan, a director of the T.V.A., secretary, and William A. Sutherland, solicitor of the T.V.A., counsel.

Housing plans for workers at Norris Dam have been announced by the Tennessee Valley Authority. Small, three-room houses, roughly 42x32 ft. in outside dimension and of 17,000 cu.ft. content will be built. All T.V.A. houses, acocrding to Earle S. Draper of the authority's staff, will be completely electrified homes. Not only will a refrigerator, range, hot water heater and outlets for lighting accessories be provided but house-heating equipment of the self-contained type will be used. A definite effort toward the evolution of modern, livable worker homes of attractive appearance and full electrified comfort is behind the program.

As a result of the approval at the November 25 referendum of a $3,225,000 bond issue for municipal ownership of an electric power system (ELECTRICAL WORLD, December 2, page 707), the Tennessee Public Service Company, subsidiary of the National Power & Light Company, of the Electric Bond & Share System, laid three proposals this week before the Knoxville City Council. It offered to sell its facilities to the city, or to lease them or to reduce rates to a structure suggested by city engineers, provided the city would not compete with the company. The Council will take the proposals under consideration promptly.

A.I.E.E. HONORS TRANSIT PIONEER

"As I look back over an active past," said Frank J. Sprague, ("the father of rapid transit"), after a bronze bust of him had been presented this week to the American Institute of Electrical Engineers by Frank Hedley, president of the Interborough Rapid Transit Company, "I often ask myself what has been the guiding impulse, and what is the heritage I most wish to leave. As to the first, there has been an impelling urge for creation, in which I have tried to be guided by the rigid tenets of a naval training and the high ethical standards of our beloved profession, and, second, that as it is better to give than to receive, to help rather than hinder, and to do rather than hesitate, it is one's highest privilege and most lasting satisfaction to contribute in some effective fashion to the general good of humanity."

P.W.A. Funds Depleted; More Municipals Backed

Though Secretary of the Interior and Public Works Administrator H. L. Ickes has made considerable point in recent publicity releases over the virtual exhaustion of public works fund of $3,300,000,000, analysis of authorizations made (ELECTRICAL WORLD, January 6, page 28) shows vast sums for state and federal projects, but little indeed for municipal light and power undertakings.

New projects suggested

Oklahoma State Department of Waterways, Power and Flood Control, recommending to the federal public works administration the proposed hydro-electric power project asked by citizens of Kaw City and Fairfax, Okla., for the Arkansas River in Osage county, has suggested also the creation of an Arkansas River Basin Authority, similar to that established for the Tennessee River and Muscle Shoals. The Oklahoma projects, are estimated to cost from $3,000,000 to $6,000,000. The Arkansas river project proposed is being protested by the Oklahoma Gas & Electric Company and the Public Service Company of Oklahoma, which contend it is not needed.

Cushing, Okla., has been allotted $350,000 for a municipal plant to consist of three 500 kw. Diesel driven generating units.

Moberly, Mo., has been allotted a grant and loan of $700,000 for a municipal light and power plant and distribution system. Other recent allotments for electric plants included $47,000 to Concordia and $155,000 to California, both in Missouri.

Allotment of $1,250,000 by the P.W.A. to Augusta for the construction of a municipal hydro-electric power plant on the Augusta Canal has been made in the hope that the canal commission will arrange with the Georgia Power Company for auxiliary or emergency power. This was half that requested.

Florence, Ala., has been allotted a loan and grant of $412,000 for the construction of an electrical distribution system, a central substation of 3,000 kva., feeder circuits from the government at Muscle Shoals office building and warehouse.

Middlesborough, Ky., has obtained a grant and loan of $325,000 from the Federal Public Works Administration for a municipal light and power plant and distribution system. The city is now served by Kentucky Utilities Company.

BURLINGTON, KAN., has been allotted a loan and grant of $145,000 for the construction of an electric power plant, including the installation of three Diesel-driven generating units.

Coming Meetings

Canadian Electrical Association, general conference of committees—Montreal, Que., February 5. B. C. Fairchild, 409 Power Bldg., Montreal.

Oklahoma Utilities Association—Tulsa, Okla., March 6-7. E. F. McKay, 1020 Petroleum Bldg., Oklahoma City.

American Society for Testing Materials—Washington, D. C., March 7. C. L. Warwick, 1315 Spruce Street, Philadelphia, Pa.

Electrochemical Society — Asheville, N. C., April 26-28. Colin G. Fink, Columbia University, New York.

Senate Investigation Asked in Missouri; Other Bills

Hope of placing Governor Park's public works program on the ballots in the form of an amendment to the State Constitution (ELECTRICAL WORLD, January 13, page 92) faded last week when the Missouri House of Representatives voted down the resolution for submission of the proposals giving constitutional authority to cities of less than 75,000 population to float bonds for the construction of municipally owned utility plants. Bills embodying these proposals had been smothered in the Senate committee on municipal corporations and as a result of this action on the part of the Senate Col. Hugh Miller, state engineer for the Public Works Administration, who had been actively sponsoring Governor Park's program, requested an investigation of the failure of the upper branch of the Legislature to pass the bills.

Governor Park did, however, succeed in having the Legislature enact a law providing for a tax of one-half of 1 per cent on specific sale transactions which include sales of electricity. The tax will be in force until December 31, 1935, unless extended by further legislation.

New utility bills in Massachusetts

Four public utility bills, two of which concern the light and power industry, have been introduced in the Massachusetts Legislature on petition of Wycliffe C. Marshall. One seeks expansion of the law requiring gas and electric companies to file contracts with the Department of Public Utilities to cover companies whose sole business in the state is supplying of electricity in bulk; the second would require that rates, prices and charges for each class of service rendered by electric or gas companies be based on the cost of each class of service.

Utility tax demanded in Ohio

In an effort to obtain new sources of revenue for the state Governor White of Ohio will ask the Legislature to boost appreciably the excise levy on utilities. "I absolutely will not permit a bill to go before the Legislature unless it carries a provision to increase the excise tax on utilities to make up for the loss of revenue from these sources sustained in real estate taxation rate reductions," he said. The Governor takes the position that the utilities should pay the same amount of total taxes they were assessed before the voters in November approved a 5-mill reduction in the real estate and tangible property tax limitation.

In his inaugural address last week Gov. George C. Peery asked authority for the Virginia State Corporation Commission to make temporary adjustments in public utility rates and for strict regulation of holding companies. To finance his school program he also recommended a tax of 3 per cent on the miscellaneous receipts of power, light, heat and water companies.

New York pleas renewed

At sessions held early this week Governor Lehman of New York transmitted to the Legislature a special message in which he urged favorable action on a twelve-point public utility program. Eleven bills were submitted by the Governor, in which were included some which the Legislature defeated last year, both at its regular and extraordinary sessions. Among old recommendations renewed by the Governor was one to permit municipalities to furnish electric and gas service to its residents and under specified circumstances, either alone or in conjunction with other cities, towns or villages, to furnish such services in areas beyond their own municipal boundaries.

The Governor renewed his recommendations that part of the cost of investigations and valuations by the Public Service Commission, not in excess of one-half of 1 per cent of its gross operating revenues during any calendar year, be assessable against a utility company investigated. Contracts of any kind made by a utility company are rendered subject to approval by the Public Service Commission, with a provision also that no charge for any service contracted for shall exceed the reasonable cost of rendering it. Loans or advances from operating utility companies to affiliates, without prior approval by the commission, are prohibited by another bill.

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N.I.S.A. Opens New Office

So active have the affairs of the National Industrial Service Association become that the headquarters of the organization, to meet the broad expansion, have been moved to 500 Fifth Avenue, New York, from Charlotte, N. C. N.I.S.A. is the sponsoring association for the code of fair competition submitted to NRA on behalf of the electrical and mechanical service industry.

At the recent annual meeting W. W. Hanks of the Charlotte (N. C.) Electric Repair Company was elected president and W. J. Wheeler of the Maintenance Company, Inc., New York, was selected as vice-president.

Senate's Views Unchanged on St. Lawrence Treaty

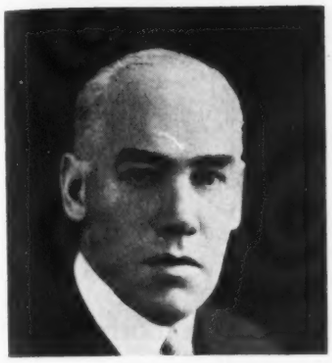
In between work on money legislation and other bills Senate administration leaders are making efforts to advance the cause of ratification of the St. Lawrence seaway pact. After lengthy debate neither side has evidenced any appreciable gain or loss in strength. President Roosevelt re-emphasized last week his interest by sending to the Senate a War Department report on the economic aspects of the project.

According to this report the completion of the waterway would enable 70 per cent of the world's ocean-going freight cargo tonnage to reach the Great Lakes and St. Lawrence River ports in the United States. The report estimated that it would serve a population of 45,000,000. The net cost to the United States was estimated at $182,726,250, provided New York assumes $89,726,750 as its share of the cost of the power dams.

Commission to Solve Cuba's Electric Problems

In discussing the program that will be followed in an attempt to bring order out of chaos in Cuba, President Carlos Mendieta has said: "This government faces grave problems. One of the first is the situation of the Compania Cubana de Electricidad, now operating under government control. A commission has been appointed to study this matter and I expect a peaceful solution about the first of next week."

President Mendieta encountered some difficulty when, just after taking office, electric power service was suspended throughout the island by a strike of employees of the electric company called by union leaders who had received a report that the new administration would immediately return the properties to their owners. The strike was called off, however, the same day and President Mendieta ordered the military authorities in control of the plants to discharge the strikebreakers who had been taken on and permit the regular employees to return to their jobs. His first official communication was a letter to the light, gas and water union, informing it that the seized properties would remain under government control until all labor difficulties were smoothed out. The men immediately returned to work (ELECTRICAL WORLD, January 20, page 128).



There is no magic formula to end all our troubles, but there are certain courses to which I believe we of the electric industry should adhere. There is no doubt that the industry should be a monopoly, therefore regulated, and that its profits should only be sufficient to attract at all times new capital at reasonable rates to provide for extensions and betterments to the property. There is no room in the utility business for speculative profits.

JOHN E. ZIMMERMANN,
President
United Gas Improvement Company.

Addressing the Corporate Fiduciaries Association of New York this week Mr. Zimmermann assailed T.V.A. with "it is manifestly absurd to use the cost of generating and distributing electricity in the Tennessee Valley as a yardstick for comparison with the generating costs" in other cities. He declared that in his opinion the rates to be charged by Tupelo, Miss., are "so astonishingly low that the municipality cannot meet the operating expenses of running its system."

Unified Federal System Seen as Future Goal

Nothing less than the development of Muscle Shoals, Boulder Canyon, the Columbia and St. Lawrence Rivers as "primary sources of power in a nationally interconnected power system," of which one of the large customers would be a "nationally unified, non-competitive railroad system, electrically operated" and giving "the lowest transportation cost in history," was the prospect unfolded before the 81st annual meeting of the American Society of Civil Engineers last week by F. H. McDonald, Atlanta consulting engineer.

Such a system of "tremendous central reservoirs of primary power" was cited as an example of the constructive use of government ownership, as contrasted with its possible destructive uses as a competitor with private enterprise, by Mr. McDonald, who advocated combining the good points of both private and public ownership for the common benefit through the development of "what may be called state mutual power companies on a state-limited basis." In these companies "private enterprise would retain the management, with public ownership carrying advisory managerial functions as to rate structure and the scope of operation, and with both private enterprise and the people participating in ownership and in resulting profits."

The present system?

The investment now held by private ownership, according to this plan, would "gradually be amortized by these state mutual companies through payments from existing rate structures, maintained at promotionally tenable levels over future periods."

"As this amortization of present investment progresses," Mr. McDonald explained, "the resulting percentage of net revenue can be diverted as income to the people of the state."

Alongside these state-limited mutual power companies, which would be confined to supplying only "stand-by power," would be the "super-power plants" to be operated by the federal government as "sources of primary power."

Accounting Order Protested by New York Utilities

Petitions have been filed with the New York Public Service Commission by the Consolidated Gas Company and its affiliated electric and gas companies for a rehearing on that body's recent orders requiring these companies to install a new uniform system of accounts. The new system, in preparation for nearly a year and a half, was to have been effective January 1, 1934 (ELECTRICAL WORLD, December 9, page 742). The petitions ask that the effective date be postponed to January 1, 1935.

The companies claim that the commission has failed to accord them a hearing on questions undertaken to be determined by the commission's order and new uniform system of accounts in the manner required by law and has refused to accord the companies the right to cross-examine employees of the commission and others whose reports and opinions were received by the commission *ex parte* and were used as a basis of the order and uniform system of accounts. The proceeding as conducted by the commission was arbitrary, capricious and in violation of the rights of the companies, they claim.

Jurisdiction question raised

Provisions of the commission's order requiring what is described as "depreciation accounting" are also protested by the petitions, which state that they are beyond the power, jurisdiction and authority of the commission to prescribe and are an invasion of the field of management of the companies. Provisions requiring installation and maintenance of a continuing property record of operating property, based upon "original cost" as defined in the order, and the completion of the installation not later than two years after the effective date, are arbitrary, unjust and unreasonable and beyond the authority of the commission, the companies declare.

Research Raises Value of Aluminum for Reflectors

Out of the research by Dr. R. B. Mason of the research laboratories of the Aluminum Company of America, assisted by the General Electric Illuminating Laboratory, has come a new, easily cleaned, weather-resistant aluminum reflector material. It is made possible by the Alray process, an electrolytic brightening method which gives white sapphire surfaces or diffusing frost-like appearing surfaces of reflectivity up to 87 per cent, as compared with regular aluminum of 74 per cent reflectivity. This aluminum material, shortly available for lighting fixtures, has a finish highly resistant to weather, fumes and stains. It can be easily cleaned with soap and water. The finish is an anodically oxidized coating, hard and transparent.

Air Pollution Reduced 85% in Three Years

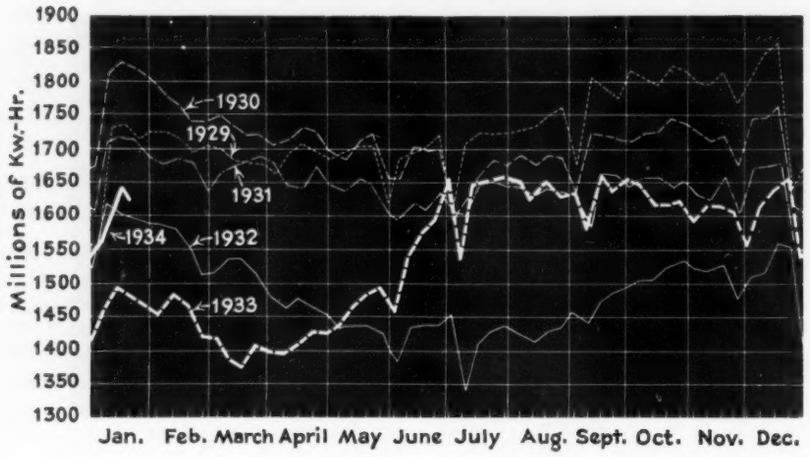
Reporting upon the results of a three-year campaign for the reduction of smoke pollution of the atmosphere the Hudson County (N. J.) Department of Smoke Regulation shows in its annual report an abatement in those three years of 90 per cent in violations, or about 85 per cent actual smoke elimination.

"I lay this improvement," states Smoke Abatement Engineer William G. Christy, "chiefly to the fact that fuel users are sold on the idea that they save fuel in proportion to the smoke they abate, and have found in practice that it is true. I find it necessary to take court action against only those who 'have no time to abate smoke.'"

St. George Hotel Dark

One of the world's largest hotels, the St. George, Brooklyn, N. Y., was dark last week for several hours while candles and flashlights flickered through unaccustomed gloom. The St. George, when rebuilt some years ago, became a center of electrical engineering attention. Its ballroom was lighted by colorama. Its swimming pool was one of the first to have a sunlamp-lighted beach. A fire in the generator of the hotel's private plant brought the interruption to service.

Output 9.5 Per Cent Over 1933



Output of electric light and power plants during the week ended January 20, announced by the Edison Electric Institute as 1,624,846,000 kw.-hr., exceeded last year's for the corresponding period by 9.5 per cent and 1932 by 1.7 per cent. The decrease of 21,400,000 kw.-hr. from the preceding week was in line with the usual change that comes with lengthening daylight, but was somewhat larger than in other years. Production is running about 11 per cent under that of 1930, the highest January on record.

Conspicuous among the regional figures is the continued excess over 1933 of nearly 20 per cent in the Mountain States and 13 per cent in the Central industrial area. New England and the Middle Atlantic region show increased gains.

Weekly Output, Millions of Kw.-Hr.

1934	1933	1932
Jan. 20...1,625	Jan. 21...1,484	Jan. 23...1,598
Jan. 13...1,646	Jan. 14...1,495	Jan. 16...1,602
Jan. 6...1,564	Jan. 7...1,426*	Jan. 9...1,619
1933	1932	Jan. 2...1,524
Dec. 30...1,539	Dec. 31...1,415	1931
Dec. 23...1,657	Dec. 24...1,554	Dec. 26...1,565

*Slightly revised from data previously published.

Per Cent Change from Previous Year

Region	Week ended Jan. 20	Jan. 13	Jan. 6
New England	+10.0	+ 9.2	+ 8.7
Middle Atlantic	+ 9.3	+ 8.6	+11.3
Central Industrial	+13.0	+13.1	+13.0
West Central	+ 5.6	+ 8.8	+ 9.3
Southern States	+ 7.7	+10.4	+ 1.3
Rocky Mountain	+18.2	+19.8	+19.1
Pacific Coast	+ 2.0	+ 3.5	+ 3.4
United States	+ 9.5	+10.1	+ 9.7

British Energy Output 10.7 per Cent over 1932

In line with the trend for some months past, there was in December a sharp increase in energy output according to official statistics rendered to the British Electricity Commission. Energy generated was 1,536,000,000 kw.-hr., an increase of 21 per cent over corresponding figures for 1932. Last year 13,554,000,000 kw.-hr. was generated in Britain, an increase of 1,313,000,000 kw.-hr., or 10.7 per cent, over the 1932 figure. The December increase compares with 13.2 and 15.4 per cent for the previous two months, and the yearly total is the high of a five-year increase from 9,073,000,000 kw.-hr. in 1928.

Austrian Railway Electrification

Some part of a recently floated government loan will, it is announced by the Austrian government, be devoted to the furtherance of railway electrification projects in that country in 1934. The new plan involves the southern section of the Tauern Railroad and a section of double-track main line from Vienna to Salzburg. The capital expenditure involved in the electrification of the Salzburg Attnang Puchheim double-track main line is estimated at approximately $5,000,000.

Canadian Hydro Gained 270,210 Hp. in 1933

New water power installations totaling 270,210 hp. were brought to completion in Canada during 1933, but no new undertakings of magnitude were initiated, according to the annual review of hydro-electric progress prepared by the Dominion Water Power and Hydrometric Bureau of the Department of the Interior. This addition, together with 16,600 hp. completed in 1932 but not previously included in the total for that year, brings the total at the end of 1933 to 7,332,070 hp.

The increase during 1933 resulted chiefly from the completion of the Masson development of the Maclaren-Quebec Power Co. on the Lievre River and the bringing into operation of the initial installation of the Canyon development on the Abitibi River in Ontario by the Hydro-Electric Power Commission. The principal developments in the various provinces are briefly described in the annual report.

The most notable and encouraging feature of the year has been the recovery in power demand. In October it reached the all-time high for any month.

Electric Locomotive Use Rises in Industry

Significant of the effect of greater manufacturing activity on the capital goods industries, recent quarterly reports by the Bureau of the Census on shipments of mining and industrial electric locomotives show pronounced gains. The accompanying summary for three consecutive years is based on data reported by ten manufacturers, comprising practically the entire industry.

Year	Total No.	Total Value	Mining No.	Mining Value	Industrial No.	Industrial Value
1931..	227	$1,317,287	203	$933,961	24	$383,326
1932..	52	217,543	52	217,543	..	.....
1933..	111	411,707	94	367,291	17	44,416

Electrification in Mexico May Soon Be "Federalized"

Approval by the majority of the state legislatures of a measure "federalizing" the electrical industry in Mexico has recently been given. The measure was passed both by the Chamber of Deputies and Senate nearly two months ago, but it was necessary to send the bill to the state legislatures. The next step by the government will be the appointment of a national committee of electricity, the purpose of which will be to seek the electrification of the industry of the whole republic and to study the possibilities of erecting electrical plants throughout the country so that every village will be able to enjoy electric light.

Agitation over rates, employee relations and American control has long persisted.

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Utilities Franchise Upheld

As the result of an order issued by Circuit Court Judge Ralph Hughes, making permanent a temporary injunction granted a year ago forbidding city officials of Richmond, Mo., to install an energy unit in the water plant, the waterworks in that city will continue to purchase its electricity from the Missouri Gas & Electric Company. The court held that the city had granted the utility company a franchise to furnish power to the city and under this agreement city officials could not install a unit that would take business away from the company.

As to Rates——

• Pacific Gas & Electric Company's gas and electricity consumers in Sacramento paid the company $3,243,361 for service in 1932, assuring the utility a 12.25 per cent return on its electrical investment and 21.4 per cent on its gas system, according to a preliminary valuation report submitted recently by the state Railroad Commission to City Manager J. S. Dean.

Detroit case to Supreme Court

• Detroit Edison Company's rate case, involving a cut of $1,500,000, will be brought to the Michigan Supreme Court when that body is called upon to decide if the Ingham Circuit Court has sufficient jurisdiction to deny a motion by the state to dismiss petitions before the lower court to revise the cut order. The state contends a Circuit Court cannot revise the rates ordered by the Michigan Utilities Commission unless the rates are confiscatory. The city of Detroit and the Michigan Manufacturers Association have asked the lower court to change the rates, contending they have not been reduced sufficiently. The Edison company also seeks to set aside the order, having voluntarily granted rate reductions approximating $1,000,000.

• Indianapolis Power & Light Company has been charged with overcapitalization of its issues of bonds and preferred stock by Sherman Minton, public counselor. Were the capitalization cut 75 per cent, stated accountants, the light company would save $750,000 a year. Hearing of an order to show cause why electric rates in Indianapolis should not be reduced has been set by the commission for February 1.

Court protests New York order

• Consolidated Gas Company's properties won a stay last week of the New York Public Service Commission's rate reduction order (ELECTRICAL WORLD, January 20, page 131) and Supreme Court Justice Schenck, who granted the stay, declared that methods used by the commission were prejudicial to the companies. The formula used in adopting the lower rates was sanctioned neither by statute nor judicial decision. "It is undoubtedly true," he declared, "that these petitioners have accumulated a very large surplus, but the law does not require utilities to give up, for the benefit of future consumers, any part of the accumulation from past operations."

• Central Illinois Electric & Gas Company has informed the Illinois Commerce Commission that it proposes to reduce electric rates in the Rockford area by approximately $150,000 annually. The reduction is supplemental to one of $155,000 ordered in September.

• Ohio Edison Company's parleys with city officials at Akron halted last week when Robert C. Ryder, chairman of the City Council utilities committee, announced that Council would take immediate steps toward the acquisition of a municipally owned power system. After being notified in a letter from L. G. Tighe, Ohio Edison vice-president and general manager, that the company had rejected the Sanderson-Bixler rates, which would save individual consumers approximately 90 cents a month, Mr. Ryder informed the utility official that Council refused to negotiate further.

• Potomac Electric Power Company at a recent hearing before the Public Utilities Commission offered a new schedule of rates for 1934 designed to reduce electric power bills by $378,918 as compared with 1933. The amount of the reduction represents one-half of the company's excess earnings above 7 per cent last year. During that year it had net earnings of $5,080,999 on a rate base of $61,759,448, equivalent to a return of 8.23 per cent. None of the reductions offered affect the primary rate, which is in most cases 3.9 cents per kilowatt-hour.

Municipal Items

SULLIVAN, MO.—Circuit Judge McElhinney of St. Louis County has taken under advisement the injunction suit brought by the Missouri Electric Power Company to prevent the city from constructing a municipal light and power plant and distribution system (ELECTRICAL WORLD, January 13, page 95). The court gave both sides 25 days in which to file briefs.

IOWA CITY, IOWA.—City Council has submitted for P.W.A. approval a municipal light and power plant project that will entail an expenditure of $917,000 for plant, equipment and distributing system.

ALLEGAN, MICH.—Despite a federal court injunction restraining this city from issuing bonds for a municipal power dam project, voters have gone on record in a special referendum approving bond issues and granting a franchise for operation of a municipal plant. The vote was 1,016 to 178.

BRAINERD, MINN.—Proposal to construct a municipally owned electric plant to compete with the Minnesota Power & Light Company has been defeated by a vote of 1,079 to 658 based on reports from nine out of ten precincts.

GILLETTE, WYO.—It is proposed to build a steam-generating plant in this city and use coal from the Black Hills of South Dakota if $90,000,000 can be borrowed from the public works fund. More than a dozen communities in northeastern Wyoming and western South Dakota would be served. The organization proposing the venture is the Black Hills Power Association.

ST. PAUL, MINN.—An ordinance passed January 11 by the City Council provides for the issuance of $10,230,000 in bonds for construction of a municipally owned electric plant to provide for approximately 40 per cent of the necessary service. Bond ordinances passed by the Council are not legal in St. Paul until they have been ratified by a majority vote at an election. Mayor Mahoney told the Council that he proposed to submit a resolution which would put the bond issue proposal before the voters at the city primary election, March 6.

MCCOOK, NEB.—City Council has been forced by a defect in procedure to repeal the ordinance calling an election January 30 to vote $250,000 bonds to construct a light and power plant. A later ordinance fixes the election for February 6. The city plans on federal aid. The Nebraska Light & Power Company, which operates a $400,000 plant in this city, protested before the state public works advisory board against any recommendation for aid that would produce unfair public competition.

BURLINGTON, VT.—Voters have authorized the City Council to issue bonds for $178,000 to cover the city's share of the cost of installing Diesel engine generating equipment in the municipal electric light plant.

DOTHAN, ALA.—City Council has voted 5 to 4 to refuse to allow the Alabama Power Company to keep its poles and wires in the city where they were constructed several years ago.

OSKALOOSA, IOWA—Election will be held February 10 on a $322,883 bond issue to finance the construction and equipping of a municipal light and power plant.

MCCOOK, NEB.—City Council has set January 30 as the date for a special election on a $250,000 bond issue for the construction of a municipal light and power plant and distribution system.

NORMAN, OKLA.—At a popular referendum voters turned down a proposal to issue $360,000 in twenty-year 6 per cent bonds, with which it was proposed to build a new municipal light and power plant and to purchase the distribution system of the Oklahoma Gas & Electric Company.

PLAINVIEW, TEX.—In Federal District Court in Fort Worth, Judge James C. Wilson has overruled a motion to dismiss the suit of the Community Power & Light Company against this city to restrain the municipality from constructing a power and light plant.

FINANCIAL · · · BUSINESS

A.S.M.E. Committee Surveys Capital Goods

Seeking to "study the prospects for the revival of the industries producing capital goods" and "determine the attitude of industrialists toward outlays for new machinery," a special committee of the American Society of Mechanical Engineers has just completed a comprehensive survey. Studies were made of 169 concerns in Worcester, Mass.; Philadelphia, Pa.; Atlanta, Ga.; St. Louis, Mo., and Milwaukee, Wis. Optimism was the strongest element disclosed.

To seven specific questions were replies tabulated. The questions and answers were:

1. How much have codes of fair practice increased production costs (increase 146, decrease 5). The increases range from 8 to 100 per cent.
2. Have prices been raised to meet the increase in production costs? No, 68. Yes, 24.
3. Have you recently surveyed your production costs? Yes, 103. No, 47.
4. Have you definite plans for the early modernization of equipment? No, 115. Yes, 51.
5. What is your present policy toward capital investment? Do not expect to make such investment, 94. Do expect to make such investment, 68.
6. Has the NRA helped toward self-government in your industry? Yes, 78. No, 78.
7. Are you optimistic, pessimistic, or neutral toward the general business outlook? Optimistic, 112. Pessimistic, 35. Neutral, 22.

Holding the Pace

Clouded only by the possible inability of the present activity of trade to maintain itself if, as threatened, widespread reductions in C.W.A. employment and payments to farmers are made, business skies are bluer and brighter than for many a long day. Some observers see the cut in expenditures as but a show of "rightness" to aid current federal financing problems and look for resumed spending ere long. The clouds are small ones.

Trade barometers, excepting few, show sustained strength. Carloadings 11.1 per cent over previous week and 9 per cent over last year. Steel output at 34 per cent, against 32.5 per cent previously. Automobile production, at 34,293 units a week, exceeds previous week and comparative interval of a year ago. Cotton forwardings exceed previous week and that of 1933. Retail sales resume improvement after early January lapse. Less encouraging were bituminous coal output and energy production; both down slightly. The National Industrial Conference Board characterizes gains in production and trade in December and early January as more than seasonal.

Prices tell much the same story. Commodity price indexes stand near the recently achieved high point of the past three years. Security markets boom wildly.

N.R.A. Considers Codes; Contractors Have Hearing

Into the hands of NRA have the various branches of the electrical industry, N.E.M.A., E.E.I., N.E.W.A., N.I.S.A. and N.E.C.A. delivered their code drafts and revisions. Judgments awaited, the week passed with no indication of action except on the contractors' code.

Before acting Deputy Administrator B. R. Value revisions for the pact sponsored by the National Electrical Contractors Association were heard. L. E. Mayer, president of N.E.C.A. told of working arrangements with the International Brotherhood of Electrical Workers which would assure harmony. L. W. Davis of N.E.C.A. showed that it represented 56 per cent of the contractors doing 57 per cent of the business.

N.I.S.A. voices opposition

The first opposition to the code was voiced by Wilson L. Townsend, counsel for the newly organized National Industrial Service Association, who asserted that his group represented the "repairing and servicing branch" of the electrical industry and spoke for strictly "service" shops which felt they had been included improperly under this code. Labor provisions of the code under discussion, he asserted, would work an undue hardship on his clients, who would resist "by every means at their command" any attempt at their control by any other industry.

On behalf of the Machinery and Allied Products Institute, and speaking also for the Baldwin Locomotive Works, R. L. Bradshaw presented an amendment which would exclude from the code such electrical work as was carried on by manufacturers within their own plants and performed by their regular employees solely for the manufacturers' own use or for inclusion in their own products. Noel Sargent, representing the National Association of Manufacturers and speaking for 21 additional trade groups, likewise objected to the inclusion under this code of maintenance and service electricians employed in industrial plants. The hearing was adjourned to January 31.

Bond & Share Reveals Profits and Salary Lists

Figures showing large profits in service fees collected by the Electric Bond & Share Company from associated and affiliated companies were read into the record of the Federal Trade Commission last week by its examiner, Walter Meelen, as the company finally agreed to an examination of its books after a long legal contest. According to the examiner's report, Electric Bond & Share realized a profit in 1927 of "269 per cent of profit to cost of services rendered for profit," and in 1931 157 per cent.

A summary by the commission of figures read into the records gave the total income of Electric Bond & Share as $18,513,300 in 1927 and $23,962,763 in 1932. Income resulting from contract services as distinguished from income from investments, etc., totaled $9,373,172 in 1927 and $11,248,273 in 1931. Regarding salaries in 1931, the report stated that 433 of the 1,215 employees received $1,000 to $2,000 a year and ten $50,000 or over, with an aver-

It is not the expansion of credit that we need. It is the use of credit which we need. We now have eight or nine billions of inert potential credit in our banking system and we cannot get it used.

OWEN D. YOUNG,
Chairman General Electric Company.

Testifying before the Senate banking and currency committee on the administration's pending monetary legislation, Mr. Young warmly and repeatedly urged that such legislation be considered as an emergency measure rather than one to effect a permanent change.

age of $74,963. Company representatives were quoted as stating that as of December 4, 1933, only four officers were receiving $50,000 or more, with the average being $71,625.

Five-Year Sentence Given Manhattan Electric Head

Convicted this week of mail fraud, Richard H. Brown, former president of the Manhattan Electrical Supply Company, and Charles H. McCarthy, stock pool operator, each received five-year prison sentences from Federal Judge John M. Woolsey. The trial marked one of the first uses of the mail-fraud statute as a weapon to prevent market operators from forming pools to raise prices of stocks artificially and then "pull out the plug," which in this case, cost investors more than $6,000,000 when shares of the company dropped in one 1930 day from $55.50 to $25.

In his charge to the jury Judge Woolsey pointed out that Brown was paid $100,000 a year as president of the company and that he had sought to obtain control of its stock. The company itself, he further pointed out, had nothing to do with the formation of the pool.

Associated Issues Rejected by Wisconsin Commission

In an order made public last week the Wisconsin Public Service Commission refused to register for open sale in that state eight issues of debentures of the Associated Gas & Electric Corporation. By its order the commission sets a precedent in American securities law. The commission refused to permit corporation solicitors to canvass Wisconsin and permits contact with prospective Wisconsin buyers only by mail. The issue of debentures is the largest unit of securities proposed for registry under Wisconsin blue sky statutes enacted during the last regular session of the Legislature. The debentures, four issues of which are due in 1973 and four in 1978, were issued in a program of refinancing $261,233,817 in outstanding funded debt owned by the parent of the corporation, the Associated Gas & Electric Company.

The order is the first issued by the commission under the new securities law, which requires that all securities, regardless of stock exchanges on which they are listed, be registered and approved by the securities division of the commission. The commission maintains that (1) the proposed plan of business of the corporation is contrary to public policy in three respects—the huge and complicated structure of the concern with its subsidiaries prevents the investor ascertaining its financial condition and operation results, an attitude of concealing essential facts has been evinced by the company's agents, and operating income is not adequate to meet even interest charges on the debentures; (2) plan of financing would be unfair and inequitable because it discriminates in favor of persons holding securities eligible for exchange under the first of three options and because holders of outstanding securities are asked to take a loss of interest or principal in exchanging them for new debentures, but common and outstanding preferred-stock holders sacrifice nothing; (3) none of the concern's advertising has complied with the statutory requirements for adequate information concerning assets, liabilities, profits, losses and other material facts concerning the issues and its business or plan of business.

Utility Stock Advance Halts

Though the general market for common stocks continued to rise, light and power shares left the "Electrical World" average at 24.6, just where it stood last week.

$4.83 a Share Earned by Detroit Edison

Consolidated net income of the Detroit Edison Company and subsidiaries for the year 1933 amounted to $6,146,369, equal to $4.83 a share on 1,272,260 shares of capital stock, comparing with 6,633,103, or $5.21 a share, earned in 1932. Surplus at the year-end totaled $18,899,951, comparing with $18,239,156 at the end of 1932. During the year $5,129,224 was expended for the construction of new plant or the replacement of old. From this is to be deducted the gross book value of plant retired from service, $4,854,899, to show a net increase in the plant account of $274,325, which is the smallest in any year since the company was incorporated.

It is interesting to note that the company paid over to tax collectors 12.7 cents out of each dollar billed to customers for service and in addition 3 per cent for sales taxes, which the company was required to bill to them.

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Utility Dividend Changes

National Power & Light Company has declared a dividend of 20 cents a share on the common stock, comparing with 25 cents previously paid quarterly by the company.

Central Power & Light Company has taken no action on the quarterly dividends on the 6 and 7 per cent preferred stocks due at this time. Three months ago the company paid dividends equal to one-quarter the normal rate of $1.50 and $1.75, respectively, while payments equal to one-half of the regular rates were paid six and nine months ago.

Northwestern Public Service Company has declared dividends of 87½ cents on the 7 per cent cumulative preferred and 75 cents on the 6 per cent cumulative preferred, both payable March 1 to stock of record February 20. Although these payments represent only one-half of the normal quarterly rates, they mark a resumption of payments, the last previous disbursements having been on June 1, 1933, when regular quarterly dividends of $1.75 and $1.50, respectively, were paid.

General Electric Awarded New York Institute Medal

"For pioneering in industrial research," the General Electric Company will be presented with the gold medal of the American Institute of the City of New York on February 1. Dr. H. H. Sheldon, president, will make the presentation speech at the Museum of Natural History. The American Institute, founded more than a century ago, includes among its objectives the recognition of achievements in science which have profoundly influenced human affairs. The council of awards has decided that the establishment of and maintenance of the General Electric Research Laboratory, created in 1900, has been a benefit to human progress and the industry.

This is the first time that the General Electric Company has been cited for an award as a corporation, though its scientists and engineers have been cited many times for achievement awards.

Canadian Gas Competition Follows Electric Plans

Following the example set by the Ontario Hydro-Electric Power Commission with its "Free Water Heater Plan," Canadian gas companies have entered the field of water heating with a substantially identical scheme for a number of cities. In the Windsor territory the Windsor Gas Company, Ltd., has a plan which calls for installation of new gas water heating equipment of high quality, entailing no first cost to the consumer, but eventually becoming his property through a small monthly charge, added to the cost of gas used. The equipment consists of a heavily insulated storage tank, guaranteed to last eight years and of much heavier and more substantial construction than the usual type of water tank; a thermostatically controlled burner which automatically cuts off the gas as soon as the tank temperature is raised to the required degree, and means whereby, on occasions when more than a normal supply of hot water is required, the customer may "speed up" the heater.

A similar system has been announced in London, Ont. Here again the equipment operates at three heats, high, medium and low, and is so arranged that the user may gage the supply of water needed for domestic purposes. The equipment is automatic in operation and provides a constant supply of water at any of its three heats.

The New Brunswick Power Company, Saint John, N. B., has announced a plan whereby a special monthly flat rate is quoted covering continuous hot water supply. A new principle in heating hot water by automatic storage gas makes it possible for citizens to obtain from 50 to 75 gal. of hot water daily on a flat rate.

Burgess Battery Provides Silver Dollar Payroll

Last week the 500 employees of the Burgess Battery Company at its Freeport, Ill., plant were paid in silver dollars; 40,000 of them constituted the half-monthly payroll and one-and-a-third tons represented the weight.

Dr. Burgess, chairman of the board of the company, has long been an advocate of silver in the monetary system of the country and took this spectacular step to lead at least one community to think widely of the pros and cons of the silver dollar as well as to enable a study of the distribution of payroll funds to merchants and through varied spending. The distribution in Freeport, Ill., represented about $2 per inhabitant.

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Kiro Dam Rejected

Rejection of the plan to construct a dam at Kiro on the Kansas River for power, flood control and as an aid to navigation on the Missouri River was recommended in the report of Major-Gen. E. M. Markham, chief of army engineers, to the War Department this week. The general gave the administration's approval of the Fort Peck project in Montana to aid Missouri River navigation as the reason for the rejection. He suggested that for flood-control purposes Kansas City and Topeka, as well as other cities in the lower valley, should construct levees at their own expense.

Federal Hydro Aid Hit

Vigorous objection to the fostering of hydro-electric projects by the government was expressed by the soft coal industry in a code meeting at Washington this week. The industry's NRA board, meeting here with Division Administrator Kenneth M. Simpson, declared "grave injury" resulted from the practice of the government, acting through the T.V.A., P.W.A. and other agencies, in loaning money directly for the construction of hydro-electric works. It urged full consideration of the effects of such loans "on this and other industries."

New York Metal Prices

	Jan. 13, 1934 Cents per Pound	Jan. 23, 1934 Cents per Pound
Copper, electrolytic	8.00	8.375
Lead, Am. S. & R. price	4.00	4.00
Antimony	7.25	7.20
Nickel ingot	35.00	35.00
Zinc, spot	4.60	4.65
Tin, Straits	53.00	51.50
Aluminum, 99 per cent.	23.30	23.30

Major New Construction This Week

Southern California Edison Company, Los Angeles, Calif., has authorized $1,500,000 for new distribution lines and extensions in 1934.

St. Paul, Minn., votes March 6 on $10,230,000 bond issue for electric light and power plant, to provide about 40 per cent of present demand.

Appalachian Electric Power Company, Roanoke, Va., plans extensions and improvements in local distribution lines, power substations and service facilities in 1934, to cost about $150,000.

Heavy-duty motors and controls, regulators, conveyors, etc., will be installed at Hammond, Ind., mill of Youngstown Sheet & Tube Company. Cost $135,000.

Burlington, Kan., has $118,000 for new municipal electric light and power plant and distribution system.

Electrical, illuminating, communications and standardizing laboratories, transformers and instruments will be installed at University of Virginia, at cost of $379,000.

Hampton, Iowa, plans $180,000 city-owned electric light and power plant through federal aid.

Motors, controls, transformers, conveyors, etc., will be installed in new plant of Post Office Department, at Reedsville, Va., for manufacture of furniture, fixtures and equipment. Appropriation of $525,000 authorized.

Mount Tivy Winery, Inc., Fresno, Calif., plans $100,000 extension and improvements.

Cleveland, Ohio, plans extensions and improvements in city-owned electric light and power plant, including equipment to cost $200,000.

Motors, controls, conveyors, lighting equipment, refrigerating machinery, etc., will be installed by Midway Public Market Company, St. Paul, Minn. A $750,000 project.

To Push Pecos River Project

As a final step toward starting construction of the proposed dam and hydro-electric plant on the Pecos River at Red Bluff, the Texas State Board of Water Engineers has granted the Red Bluff Power Control District a permit to store 300,000 acre-feet of water, to be jointly used for irrigation and the generation of electric power. The district has voted $2,600,000 of bonds, to be used as collateral for a loan which the Public Works Administration has authorized in that sum (ELECTRICAL WORLD, November 11, page 611). Engineers estimate that the cost of the dam and spillway will be $1,635,675 and the power plant and transmission line $175,000.

MEN OF THE INDUSTRY

H. L. Farrar Heads Coast Counties Utility

H. L. Farrar has been elected president and general manager of the Coast Counties Gas & Electric Company, Santa Cruz, Calif., to succeed J. B. Wilson, resigned. Mr. Farrar went to the Pacific Coast in 1931 from the Western United Gas & Electric Company, where he served as general gas superintendent with headquarters at Aurora and Geneva, Ill. For the past two years he has been vice-president of Coast Counties company. Mr. Farrar has been active in the affairs of the Pacific Coast Electrical Association.

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ARNOLD ROTH has been given the direction of electrical apparatus manufacture for Sprecher & Schuh, Aarau, Switzerland, manufacturer of high and low tension apparatus. Mr. Roth was formerly identified with Les Ateliers de Constructions Electriques de Delle, Villeurbanne, Rhône, France.

HARRY E. MCPHERSON of St. Joseph has been appointed a member of the Missouri State Public Service Commission by Governor Park to fill out the unexpired term of J. Fred Hull, resigned. Until recently Mr. McPherson was president of the American Union Life Insurance Company of St. Joseph.

LEO H. LEARY, for the past 25 years a prominent practitioner in Boston legal circles, has been appointed a member of the Massachusetts Department of Public Utilities, succeeding Everett E. Stone, whose term recently expired. Commissioner L. F. Hardy, whose term had also expired, was reappointed to his post by Governor Ely.

L. R. CALVERT has been appointed works engineer of the Westinghouse Lamp Company, with headquarters in Bloomfield, N. J., to succeed the late E. J. Smith, to whom he was an assistant for a number of years.

MAXWELL V. SAUER, who has been associated with the Beauharnois power development since 1929, has been appointed assistant chief engineer of the Beauharnois Light, Heat & Power Company. Commencing his career in 1906 as designing engineer for the Niagara Falls Power Company, he was appointed chief hydraulic engineer of design for the Ontario Hydro-Electric Power Commission in 1918 and in 1923 became hydraulic engineer for Canadian Vickers, Ltd. Subsequently he became vice-president and general manager of William Hamilton, Ltd., Peterborough, Ont. In 1928 he was appointed designing engineer for the Northwestern Power Company and one year later he was appointed hydraulic engineer for the Beauharnois power development in charge of the design of the canal and appurtenant structures.

JAMES H. PERKINS, chairman of the board of the National City Bank, was elected last week a trustee of the Consolidated Gas Company of New York to fill the vacancy caused by the resignation of Charles E. Mitchell.

J. S. NORRIS, president of Montreal Light, Heat & Power Consolidated, has been appointed to the board of directors of the Royal Bank of Canada. Mr. Norris is president and a member of the directorate of a large number of important public utility companies.

KENNETH CURTIS, president of Curtis Lighting, Inc., has been elected president of the Electric Association of Chicago to succeed W. O. Batchelder, local district manager of the General Electric Company.

HOWARD MURRAY, who has had long experience with hydro-electric developments and is vice-president of the Shawinigan Water & Power Company, has been elected a director of the Pennsylvania Water & Power Company and of the Safe Harbor Water Power Corporation.

FREDERICK A. YOUNG, formerly chief electrical engineer of the consulting firm of Jenks & Ballou, Providence, has been nominated a member of the Rhode Island Public Utilities Commission by Governor Green, to succeed Samuel E. Hudson of Woonsocket.

E. N. HURLEY, president of the Electric Household Utilities Corporation, Chicago, and one of the receivers for the Middle West Utilities Company, has been re-elected president of the American Washing Machine Manufacturers' Association for the fifth consecutive term.

BENJAMIN F. PEARSON, manager of industrial relations for the Southern California Edison Company, retired from active duty on January 1 after nearly forty years of continuous service. Mr. Pearson entered the utility industry in California with the Redlands Electric Light & Power Company in 1896. The company organized the Southern California Power Company and began the construction of the Santa Ana River power house No. 1, which today is operated by the Southern California Edison Company as one of its several hydro-electric plants. Mr. Pearson held many offices in the Edison organization during his many years of service.

A. E. PARKER, assistant to the president of the Winnipeg Electric Company, has been elected president of the Manitoba Associated Boards of Trade. Mr. Parker is also in charge of the public relations department of the Winnipeg utility.

R. E. MURPHY has been appointed sales manager of the I-T-E Circuit Breaker Company with headquarters in Philadelphia. Mr. Murphy formerly represented the Esterline-Angus Company in Pittsburgh, and prior to that was sales manager of that company at Indianapolis, Ind.

RICHARD F. CLEVELAND, son of former President Cleveland, was appointed last week general counsel to the Maryland Public Service Commission by Governor Ritchie to succeed former Senator Bruce, resigned. Mr. Cleveland became a resident of Baltimore soon after he was graduated from the Harvard Law School in 1924.

THOMAS O. MOLONEY, president of the Moloney Electric Company of St. Louis, has been elected to the board of directors of the General American Life Insurance Company of that city.

C. J. KING, formerly president of the Smoot Engineering Coporation, has been elected president of the General Regulator Corporation, manufacturer of regulators and combustion control systems, recently organized in New York.

JOHN WEST, for the past three years manager of the northeastern district of the New England Power Association, with headquarters at Arlington, Mass., has been appointed district manager of a new grouping of the southeastern properties of the association, with headquarters at Fall River, Mass. Mr. West has been made president of the Fall River Electric Light Company besides having supervision over utility properties of this group at Attleboro, Seekonk, Franklin, Quincy, Weymouth, Norwood, Plymouth and Marion, Mass. He was formerly a partner in the engineering firm of Carver, Macomber & West and at one time power engineer of Charles H. Tenney & Company, Boston. JOHN A. HUNNEWELL, president of the Lowell Electric Light Corporation, has been appointed manager of the northeastern district of the New England Power Association, succeeding Mr. West. Mr. Hunnewell's headquarters will continue at Lowell, Mass.

OBITUARY

CHARLES S. SPAULDING, formerly superintendent of the Newburyport (Mass.) Gas & Electric Light Company, died at his home in that city January 7 in his seventy-seventh year. He was a native of St. Johnsbury, Vt., and in his early career was connected with the Wakefield and Allston, Mass., electric lighting plants. From 1900 to 1921 he was superintendent of the Newburyport company prior to its merger with the Haverhill Electric Company.

VEATOR D. MENDENHALL, designing engineer, General Electric Company, Philadelphia, Pa., died October 31 in his forty-second year. His early experience was obtained in the U. S. Navy and with the R. J. Reynolds Tobacco Company. From 1922 to 1924 he was designer for the General Electric Company, engaged on detail design of electrical switching equipment. In 1924 he became designing engineer of the company, in which position he was responsible for the design of considerable outdoor switching equipment.

ROBERT J. COCHRANE, a pioneer in the Canadian electrical industry, died January 13 at Lancaster Heights, N. B., at the age of 80. When Mr. Cochrane retired in 1932 he had been on the staff of the New Brunswick Power Company for 48 years. Starting with the St. John property when it was known as the Calkin plant, operating a tiny power house on the harbor front, he directed all construction work for the company for 35 years.

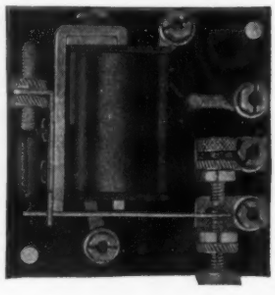
JUDGE J. M. ANDERSON, 71, lawyer of Nashville, Tenn., and in recent years connected with the legal department of the Nashville Railway & Light Company, which was merged in 1930 with the Tennessee Electric Power Company, died December 30 at his home in Nashville. He served as city attorney and criminal judge for approximately ten years and on retiring had represented certain electrical interests in his practice.

ROBERT V. DEVLIN, engineer of the industrial locomotive division of the General Electric Company, died at his home in Erie, Pa., December 20 at the age of 57. A native of Williamsport, Pa., and a graduate of Pratt Institute, he began work with the Stanley Electric Manufacturing Company, Pittsfield, Mass., in 1902 and one year later was transferred to the testing department of the General Electric Company at Schenectady. After spending several years in the power and mining department at Erie, he took charge of the industrial locomotive design division of what is now the transportation engineering department in 1921, the position he held at the time of his death. Mr. Devlin was well known in the United States and Canada in industrial and mining circles. During his more than 25 years of design work he was awarded a great many patents and others were pending at the time of his death. He was among the early advocates of the use of electric welding in the fabrication of electric locomotives.

NEW EQUIPMENT

Improved Sensitive Relay

A relay that operates on low current values and is especially adapted to photo-electric cell application is announced by Ward Electric Company. The design and construction of the magnetic circuit gives high sensitivity at low induction, good contact torque at pull-up and a drop-out that can be adjusted to 85 per cent of pull-up value. These relays will operate on about 14 milliwatts and where small gaps are permissible they can be adjusted to give positive operation on 4 milliwatts.



New Coil Winder

A new universal coil winding machine for armature, field and transformer coil winding is announced by the Ideal Commutator Dresser Company. The machine is flexible and the set-up from one type of coil to any other type can be made quickly and easily. An average set of 48 diamond coils can be made in from 30 to 45 minutes.

Split-Phase Motors

Improved resistance split-phase motors are announced by the Emerson Electric Manufacturing Company. These are $\frac{1}{4}$ and $\frac{1}{6}$ hp. at 1,725 r.p.m. and $\frac{1}{8}$ and $\frac{1}{3}$ hp. at 1,140 r.p.m. A steel field ring construction gives increased rigidity to the field structure and reduces the height of center shaft to $3\frac{1}{2}$ in. Starting or blocked torque is 150 to 250 per cent of full-load torque and maximum running torque 200 per cent of full-load torque. Temperature rise is less than 40 deg. C. A.c. and d.c. frames are interchangeable. These motors are available with either resilient or rigid base mountings in all four ratings.

Small Industrial Heaters Offer Process Advantages

Three new types of small heating units have been announced by the General Electric Company. All are metal sheathed units for specific applications and offer, respectively, low watt density and higher corrosive resistance. wide adaptability to tank volume and location, and protection against liquid discoloration.

The first has a sheath wire winding cast in a heavy block of lead and involves low watt density of 13 watts per square inch of immersed surface, a factor which should increase its life in heating corrosive solutions. The second is a copper-sheathed unit formed in a self-supporting helix with long vertical extensions ending in a plug socket. Only the spiral is active and a minimum depth of 5 in. of water can be heated. Rating is 1,300 watts at 115 to 230 volts. The third is an all monel metal unit that will not discolor oil in manufacture of ink, varnish, etc., and is rated at 12 kw. at 230 volts d.c. and single or three phase a.c.

Talkies in a Suitcase

So rapidly have sound-picture refinements and developments taken place that it is now possible to provide "talkie" equipment for the use of sales organizations, small public gatherings, etc., in so compact a space that a suitcase will contain it. Such equipment is now available through Herman A. De Vry, Inc., Chicago. These units are suitable for audiences as numerous as 1,500.

SMITHJOHNS POLE LINE BRACKETS, single and double, are made of certified malleable castings, hot-dipped galvanized. These brackets are made with ample space factor and the double bracket is furnished in two different phase spacings.